Upper 3rd
DETROIT PUBLIC LIBRARY
AUG 28 1961

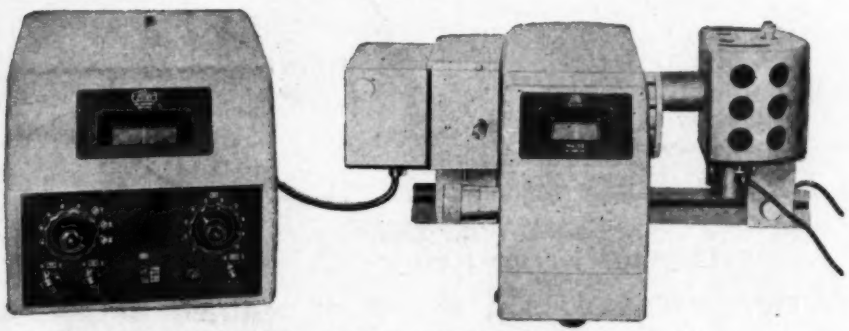
REGD. NO. BG. 263

Vol. 30, No. 6 JUNE 1961 Pages 207-246

CARL ZEISS

SPECTROPHOTOMETER

Mains-operated Model PMQ II



Made by Carl Zeiss, Oberkochen, Germany

For precise measurements from 200 mμ in the ultraviolet to 1000 mμ in the near infrared region with high spectral resolution. Write for illustrated literature.

Sole Agents

ADAIR, DUTT & CO. (India) Private LTD.

CALCUTTA MADRAS SECUNDERABAD BOMBAY NEW DELHI

IT TAKES TEN YEARS TO MAKE A SCIENTIST

And sometimes as long to find one.
India desperately needs many more.
We ourselves have none to spare.
But we do, in fact, make scientists for others.

Our ADIABATIC BOMB CALORIMETER...

the first and only commercially available set of its kind, reduces by no less than 66% the time and attention spent on other bomb calorimeters in measuring the calorific values of fuels and foods. The trick is to raise the temperature of the calorimeter jacket exactly in step with the rising temperature of the bomb. Not as simple as it sounds, of course. But now achieved, with high precision. **RESULT :** No heat losses, no corrections no tedious slavery to the thermometer; less fatigue, fewer sources of error.

Send for technical specification and prices

Highest grade stainless steel – first class workmanship – unequalled efficiency

AND 66% OF THE SCIENTIST'S TIME SAVED FOR OTHER WORK

A SCIENTIST SAVED IS A SCIENTIST MADE

And the calorimeter sets are available, not in ten years, but now, at a price at which they will pay for themselves in a matter of months.

Gallenkamp

SUPPLY THE WORLD'S LABORATORIES

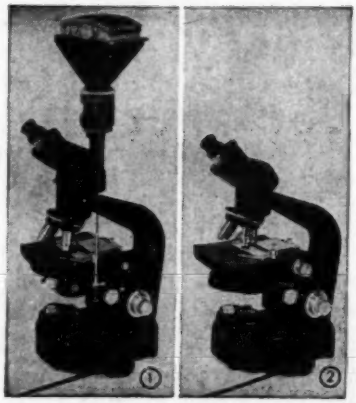
A. Gallenkamp & Co. Ltd., London, England.

ACCREDITED AGENTS

MARTIN & HARRIS (Private) LTD.,

(Scientific Department)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1.



WILD
HEERBRUGG

* The most COMPLETE Microscope so far made

* Ideal for QUALITY PRECISION & VARIETY

WILD M 20

The M 20 Microscope with few of its attachments.

Fig. 1 : With Micro Camera and Binocular Tube;
Fig. 2 : Equipped as Phase Contrast Microscope ;
Fig. 3 : With Six-Hole Nosepiece ; Filter Exchanger, etc. ;
Fig. 4 : Built-in Illuminator for Kohler Illumination.

Sole Agents:

RAJ-DER-KAR & CO.

Sadhana Rayon House
Dr. D. Naoroji Road
BOMBAY-1

Telephone : 26-2304 Telegram : TECHLAB

Branch Office:
44/6 REGAL BUILDING
CONNAUGHT PLACE
NEW DELHI-1

Gansons

- **GAS PLANTS** Electrically operated
- **GAS PLANTS** Weight Driven
  For Field Laboratories and places without electricity
- **LABORATORY EQUIPMENT AND APPLIANCES**
  Incubators, Ovens, Baths, Shakers, Stills
- **RADIOACTIVE ISOTOPES**
  Equipment for handling and storing
- **STAINLESS STEEL FABRICATION**
  Pilot Plants, Tanks, Kettles, Pressure Vessels, for Pharmaceutical, Chemical and Food Processing Industries
- **ORE DRESSING PLANTS & EQUIPMENT**
  Wilfley Tables, Froth Flotation Cells, etc.

GANSONS PRIVATE LIMITED

P.O. BOX 5576 BOMBAY-14

Ex-stock

'PYREX'

BRAND

(MADE IN ENGLAND)

Laboratory Glassware

STOCKS OF G.D.R. WESTGLAS GERMAN SCIENTIFIC GLASSWARE

for sales to actual users at prices fixed by the

STATE TRADING CORPORATION OF INDIA LTD.

Only actual users as Government Research Institutes, Universities, National Laboratories, etc., should contact:

LABORATORY FURNISHERS

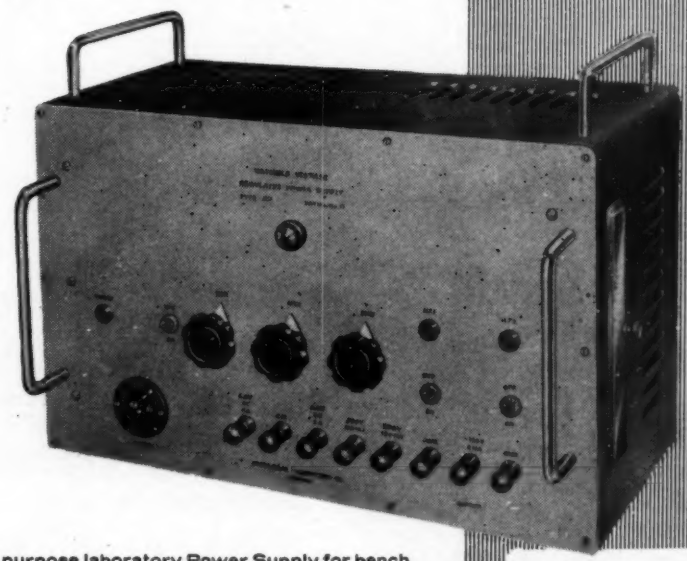
DHUN MANSION, 186, C. VINCENT ROAD

DADAR, BOMBAY 14

GRAMS: LABFURNISH, BOMBAY, DADAR PHONE: 62761

Branch: **AHMEDABAD**

TYPE S-80 REGULATED POWER SUPPLY



A general purpose laboratory Power Supply for bench use or standard rack mounting.

SPECIFICATIONS

Output 1 0-300 volts D.C. 100 m.a. regulated

Output 2 0-300 volts D.C. 100 m.a. regulated

Output 3 0-150 volts D.C. Negative 5 m.a. regulated

Output 4 6.3 volts A.C. 5 amp. unregulated.

REGULATION Better than ½% for both line fluctuations from 200-240 volts and load variation from minimum to maximum current.

Available from ready stock.

Ask for details of complete range of Regulated Power Supplies.

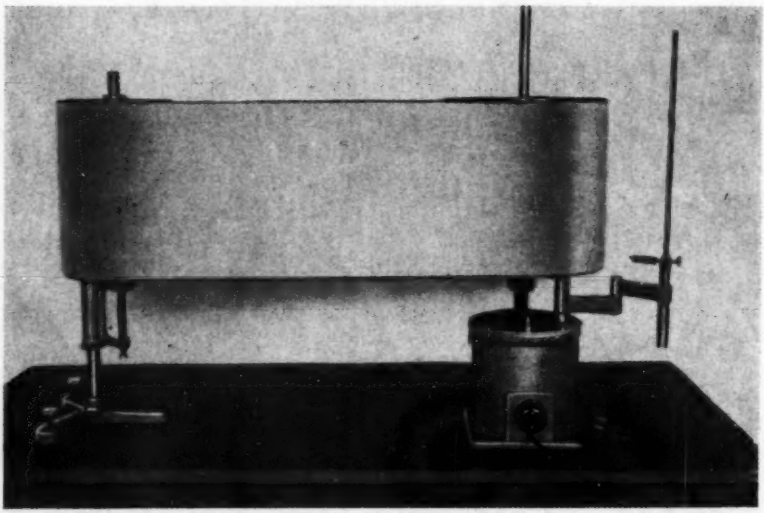
UNIVERSAL SCIENTIFIC COMPANY

32, Parekh Street, Bombay 4.

Manufacturers of Regulated Power Supplies, Electronic Test Instruments, Physics Apparatus, Special Equipment for Research & Industrial Control Equipment.

"JAQUET"

ELECTRO-KYMOGRAPHS



JAQUET ELECTRO-KYMOGRAPH NO. 1100 WITH DRUM TYPE T 33 AND TENSION ROLLER STAND NO. 1106

Please ask for full specifications

Sole Agents in India

GORDHANDAS DESAI PRIVATE LTD.

PHEROZESHAH MEHTA ROAD, BOMBAY 1

Branches at:

P-7, Mission Row Extension
CALCUTTA 1

4/2B, Asaf Ali Road
NEW DELHI

22, Linghi Chetty Street
MADRAS 1

only the best filter papers

You cannot be too careful about the filter papers you use. For consistently accurate results use only GENUINE WHATMAN papers in your laboratory. They are made by modern techniques that guarantee their quality: their properties are examined and controlled at every stage of manufacture. They are preferred by leading scientists throughout the world because with Whatman you can be sure you are getting the correct results in all filtration procedures. They have no substitute. So look at the label carefully and see that it is GENUINE WHATMAN before you buy.

ensure correct *results*

BE SURE

H. REEVE ANGEL & CO. LTD
Gt. Britain: 9 Bridewell Place, London EC4
USA: 9 Bridewell Place, Clifton, New Jersey

Sole distributors of

WHATMAN FILTER PAPERS

Manufacturers W & R Balston Ltd

METRIMPEX

pH METERS

TYPE 594: PORTABLE BATTERY pH METER

TYPE 933: TRANSISTORIZED pH METER

TYPE 924: ELECTRONIC TITRI pH METER

TYPE 922: GENERAL PURPOSE MAINS OPERATED pH METER

TYPE 7023: BIOLOGICAL TITRI METER

ALL IMPORTED UNDER RUPEE PAYMENT

Representatives

EASTERN ELECTRONICS

FARIDABAD

Sigcol

LABORATORY
GLASS APPARATUS

卐

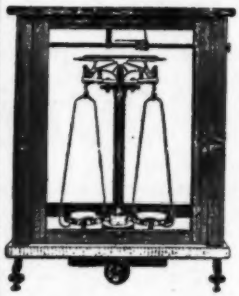
Sole Selling Agents:

GHARPURE & CO.

P-36, ROYAL EXCHANGE PLACE EXTN.

CALCUTTA 1

Gram: "MEENAMO" Phone: 22-2061



KEROY
Short Beam
Analytical
Balance

No. K 1

Really Dependable Balance for Degree Classes and Research Laboratories

Sensitiveness .. 1/10th mg.

Capacity .. .. 200 gm.

Catalogue on Request

Manufactured by:

Keroy (Private) Ltd.

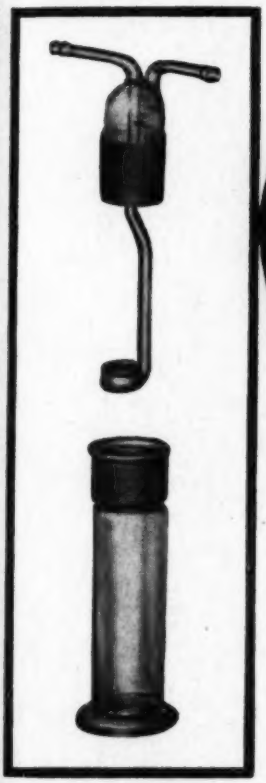
BANARAS CANTT. :: CALCUTTA 10

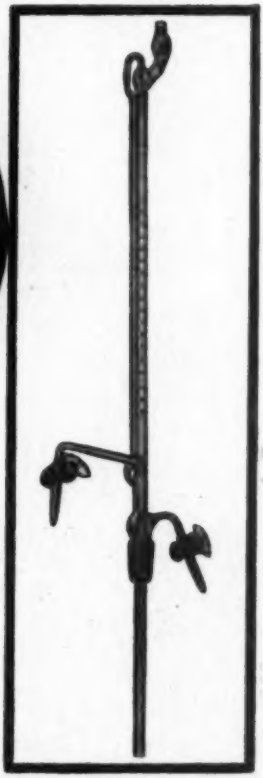
"Calcutta Telephone No. is 24-3840"

this is English

PYREX

Regd. Trade Mark





It is chosen because

'PYREX' BOROSILICATE GLASS

- withstands thermal shock—its coefficient of expansion is extremely low
- resists chemical attack
- has exceptional mechanical strength—considerably reducing replacement costs
- can easily be cleaned and sterilized *and* is constant in all its standards of accuracy and all its characteristics

ENGLISH 'PYREX'
scientific and laboratory glassware

Made in England by James A. Jobling & Co. Ltd., Wear Glass Works, Sunderland.

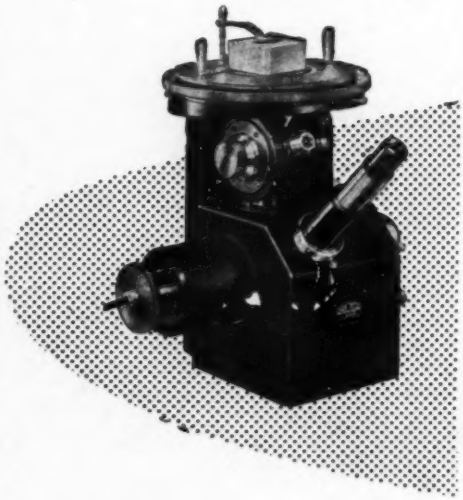
Available from all leading distributors

Sole Agents: **GORDHANDAS DESAI (PRIVATE) LTD.**
SIR PHEROZESHAH MEHTA ROAD, FORT, BOMBAY 1

Also at: **CALCUTTA MADRAS NEW DELHI**

CARL ZEISS
JENA

METALLURGICAL MICROSCOPE 'EPITYP'



BRIGHT—FIELD-WORK
MONOCULAR & BINOCULAR OBSERVATION
PLANE—FIELD ACHROMATS
ATTACHABILITY OF PHOTO-MICROGRAPHICAL EQUIPMENT "MF" AND OF TEST STRIP COMPARISON DEVICE

STANDARD VERTICAL CAMERA 9×12

FOR USE WITH ANY MAKE OF MICROSCOPE

VEB CARL ZEISS JENA

Sole Agents in India:

GORDHANDAS DESAI PRIVATE LTD.
SIR PHEROZESHH MEHTA ROAD, FORT, BOMBAY 1

Branches

P-7, MISSION ROW EXTENSION
CALCUTTA 1

4/2 B, ASAF ALI ROAD
NEW DELHI

22, LINGHI CHETTY STREET
MADRAS 1

INSIST ON

BDH

LABORATORY CHEMICALS AND REAGENTS

Their exceptional reliability and high standards of quality are recognised throughout the world.

LABORATORY REAGENTS ★ ★ 'ANALAR' REAGENTS

INDICATORS ★ ★ BIOCHEMICALS

MICRO-ANALYTICAL REAGENTS ★ ★ REAGENTS FOR CLINICAL ANALYSIS

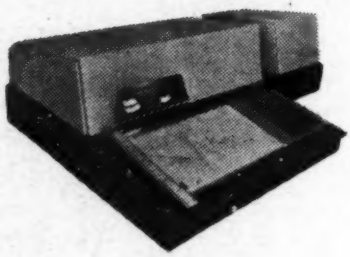
MICROSCOPICAL STAINS AND STAINING SOLUTIONS ★ ★ TEST PAPERS AND TESTING OUTFITS

BRITISH DRUG HOUSES (INDIA) PRIVATE LTD.
LABORATORY CHEMICALS DIVISION,
8 Graham Road, Bombay-1

MOST MODERN SPECTROPHOTOMETERS

Ex: M/s. BECKMAN INSTRUMENTS INC., U.S.A.

IR4 INFRA-RED SPECTROPHOTOMETER



Special Features:

* Double Beam-Optical Null—for high resolution scans.
* Double Monochromator—for high resolution and low stray light with all optics.
* Single Beam Linear Amplifier—for high quantitative accuracy.
* Simplicity—for easy operation by any technician.
* Flexibility—for most variable studies.
* Sound Design.
* Optics NaCl, LL.F, CaF2, KBR, Cs. Br.

OTHER BECKMAN SPECTROPHOTOMETERS:

DU Spectrophotometer, B Spectrophotometer, DK Recording UV-Near Infra-Red Spectrophotometers, DB Recording Spectrophotometer, etc.

'SERVICE AFTER SALES A SPECIALITY'

Sole Agents

TOSHNIWAL BROS. PRIVATE LTD.

198, JAMSHEDJI TATA ROAD, FORT, BOMBAY 1

BRANCHES:

'RIVAL', KACHERI ROAD, AJMER (RAJASTHAN)

11, BRITISH INDIAN ST., CALCUTTA 1

14-B/4, N.E.A. UTTARI MARG, NEW DELHI 5

ROUND TANA, MOUNT ROAD P.O., MADRAS 2

Current Science

Vol. XXX] JUNE 1961 [No. 6

CONTENTS

	Page
Molecular Electronics—Dr. S. W. Herwald	207
Obituary : Sir K. S. Krishnan	210
Prevention of Flowering in Sugarcane—R. R. Panje and T. Raja Rao	211
International Control of Investigations of Rare Meteorites	212
The Development and the Future of Physics	213
Raman Spectrum of Deuterated Methane (CD_4)	213
Evolution as a Test for Ethics—J. B. S. Haldane	214

Letters to the Editor

Absorption Cross-Sections for the Nuclear Scattering of High Energy Nucleons—G. Z. Shah and B. M. Thaker .. 215

Electronic Transition Moment Variation and Vibrational Temperature—N. R. Tawde and N. Sreedhara Murthy .. 216

The Effect of Sixth Degree Cubic Field On Rare-Earth Ions in Crystals—A. Mookherji and D. Neogy .. 217

Synthesis of a Racemate of Homopterocarpin—K. Aghoramurthy, A. S. Kukla and T. R. Seshadri .. 218

Enhanced Reduction Efficiency of Sodium Borohydride in the Presence of Titanium Tetrachloride—B. C. Subba Rao .. 218

Synthesis of Thioureido-Benzophenones—A. A. Munshi and J. P. Trivedi .. 219

Molybdate-Tungstate Antagonism in Neurospora crassa—A. Ramaiah and E. R. B. Shanmugasundaram .. 219

Stromatolites in Lower Cuddapah Limestones (Precambrian) in Cuddapah Basin—R. Vaidyanadhan .. 221

Separation of Rare Earths—K. N. Kartha and H. V. Bhaskar Rao .. 221

Occurrence of Ostracoda in Rocks of Paleocene Age Near Pondicherry, South India—N. Rajagopalan .. 222

Some Observations on Piedmontite from Goldongri Manganese Mine—V. K. Nayak .. 223

Insecticidal Properties of Zanthoxylum alatum *Linn.*—A. C. Mathur, J. B. Srivastava and I. C. Chopra .. 223

On the Genus Cryptococcus *Kutzing Emend. Vuillemin in India—A Preliminary Report*—R. S. Sandhu, (Mrs.) D. K. Sandhu, H. S. Randhawa and S. C. Chakravarty .. 224

Metacercaria of Aphanurus *Sp. (Trematoda-Hemiuridæ) from a Copepod* Agrocalanus gracillis *(Giesbrecht) off Waltair Coast*—P. N. Ganapati and K. Shantakumari .. 225

On the Growth of Antennæ of Gerris fluviorum *F. (Hem., Gerrididæ)*—G. T. Tonapi and B. Raja Rao .. 226

A Simple Method of Reducing Variations of Current during Electrophoresis—K. N. Govindan Nayar .. 228

A Heteropolysaccharide from Pasteurella multocida, *Roberts' Type I*—M. R. Dhanda, Prem Prakash and P. C. Sekariah .. 228

A Note on Termites (Insecta : Isoptera) Infesting Sugarcane Crop in Rajasthan—K. S. Kushwaha .. 229

An Unusual Mode of Egg-Laying in Trogoderma granarium *Everts (Dermestidæ : Coleoptera), a Pest of Stored Cereals*—Snehamoy Chatterji and Prakash Sarup .. 230

Two New Records in Soil Fungi—J. N. Rai, K. G. Mukerji and J. P. Tewari 231

Pachytene Analysis in Melilotus segetalis *Schulz.*—D. R. Ranga Rao and S. V. S. Shastry .. 232

Flint × Dent Maize Hybrids Give Increased Yields—N. L. Dhawan and Joginder Singh .. 233

Effect of Flower Suppression and Grafting on Nicotine Content in Tobacco—K. A. Patel .. 234

Variation among Rice Varieties in Regard to Germination under Submersion, and Heat Stability of Chlorophyll—P. C. Sahadevan .. 235

Reviews .. 236

Science Notes and News .. 243

ANNUAL REVIEW OF

MEDICINE

Vol. 12 **May, 1961**

Infectious Disease: Respiratory Viruses, *R. M. Chanock and K. M. Johnson*

Physiology of the Surgically Altered Stomach, *C. E. Welch and D. S. Ellis*

Malabsorption: Celiac Sprue, *C. E. Rubin*

Bile Pigment Metabolism, *G. Klatskin*

Cardiovascular Disease: Myocardiopathies, *E. D. Robin*

Cardiovascular Disease: Extracorporeal Circulation, *D. G. Melrose*

Evaluation of Pulmonary Function: Methods, *E. A. Gaensler*

Hormonal Influences on Renal Function, *L. G. Wesson, Jr.*

Kidney Disease: Acquired Tubular Disorders, *A. S. Relman and N. G. Levinsky*

Hematology: Iron Metabolism, *E. Beutler*

The Porphyrins and the Porphyrias, *L. Eales*

Neural Control of Endocrine Function, *G. Farrell and E. Rauschkolb*

Endocrine Tissue Transplantation, *J. R. Brooks*

Neoplastic Disease: Tumor Metabolism, *H. Busch and J. R. Davis*

Neoplastic Disease: Tumor-Virus Relations, *S. E. Stewart*

Psychiatry: Psychometrics, *C. L. Winder*

Psychopharmacology: Psychotherapeutic Drugs, *B. B. Brodie, F. Sulser and E. Costa*

Untoward Reactions to Antimicrobial Agents, *H. J. Simon and L. A. Rantz*

Oral Hypoglycemic Agents, *A. Marble*

Evaluation of Hazards of Radiation Exposure in Medical Practice, *L. H. Hempelmann*

Respiratory Problems of the Newborn, *C. D. Cook*

Physiology of the Placenta, *H. Prystowsky*

Dermatology: The Eccrine Sweat Glands, *W. C. Lobitz, Jr. and R. L. Dobson*

Medical Aspects of Space Flight, *A. H. Schwichtenberg*

454 pages

PLANT PHYSIOLOGY

Vol. 12 **June, 1961**

Some Aspects of Amino-Acid Synthesis in Plants and Related Subjects, *A. I. Virtanen*

Structure and Function of Mitochondria, *F. L. Crane*

Structure and Physiology of Cell Walls, *G. Setterfield and S. T. Bayley*

Minor Mineral Nutrients, *D. J. D. Nicholas*

Soil-Plant Relationships in Ion Uptake, *M. Fried and R. E. Shapiro*

Protein Synthesis, *G. Webster*

Photosynthesis Under Natural Conditions, *J. F. Talling*

Photosynthesis, *G. Hoch and B. Kok*

Phosphorylation in Higher Plants, *E. Marré*

Biosynthesis and Function of Carotenoids, *T. E. Goodwin*

Biochemistry of Senescence, *J. E. Varner*

Plant Water Deficits and Physiological Processes, *Y. Vaadia, F. C. Raney and R. M. Hagan*

Photoperiodism and the Flowering Process, *F. B. Salisbury*

Physiology of Mitosis and Meiosis, *J. H. Taylor*

Indole Auxins, *C. H. Fawcett*

Applied Aspects of the Gibberellins, *N. W. Stuart and H. M. Cathey*

Kinetin and Related Compounds in Plant Growth, *C. O. Miller*

Geotropism in Roots and Shoots, *H. Rufelt*

Photochemical Air Pollution Damage to Plants, *J. T. Middleton*

Physiology of Wilt Disease, *T. S. Sadasivan*

502 pages

each $ 7.50 postpaid

Annual Reviews, Inc., Grant Ave., Palo Alto, Calif., U.S.A.

MOLECULAR ELECTRONICS

DR. S. W. HERWALD
Westinghouse Electric Corporation

EFFORTS to elevate air and space craft to new plateaus of capability are continually made more difficult through a technical paradox. As we make these craft more sophisticated through the use of advanced electronic gear, the risk of failure among components and connections grows. And as we add this more complex electronic equipment it becomes more difficult to provide for its weight and size. The problems of improvement of reliability and reduction or weight and size of electronic equipment may be approached in several ways. But such techniques as better quality control on components and connections, and miniaturization, while exploiting modern technology, do not yield maximum reliability.

In the recent past, a substantial part of Westinghouse research and development effort has been focused on a new approach to both problems. It exploits a new concept in the design and function of electronic systems. In fact, it is a broader concept of electrical engineering which we call "molecular electronics" to indicate its dependence on phenomena occurring within or between domains of molecules in the solid state. In this programme a variety of molecular electronic "function blocks" are now being produced, three of which are shown in Fig. 1, as solid-state elements that achieve,

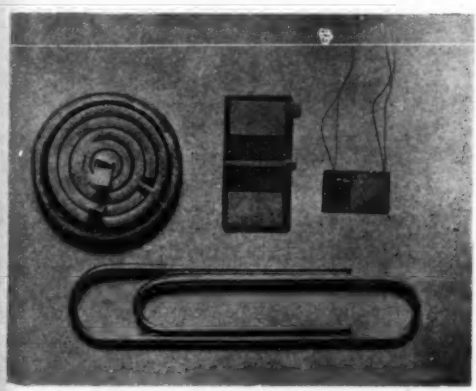


FIG. 1. Three of eight molecular electronic function blocks demonstrated as subsystems. Device bearing concentric arcs is an audio amplifier at centre is a free running multivibrator, and at right, a two-stage video amplifier.

entirely within themselves, electronic results such as have been gained only by assembling many, varied items of electronic hardware. Because of this, these elements are not intended as "components", as we think of transistors and tubes, but rather as "subsystems" since each of the function blocks has the ability to achieve an electronic result which is essential if all the subsystems in the entire system are to work together effectively. These function blocks perform such electronic operations as amplification, oscillation, telemetering, etc.

Because there are no internal connections or components, and the only external connections needed are those for coupling inputs and outputs to the complete system, it is possible to build subsystems whose risk or failure should be equal to or less than that of familiar solid-state devices and perhaps one-thousandth of that for a subsystem built of many parts for the same purpose. This ability of molecular electronics to reduce the number of components and connections required is illustrated by a comparison of three designs for a light telemetering subsystem, Fig. 2. When designed to use electronic tubes, this subsystem required 16 components and 18 soldered connections; when designed to use transistors, it required 14 components and 15 connections. In contrast a molecular electronic subsystem developed to achieve the same purpose needed but one component and two connections. Also, because their internal functions involve distances of the order of a few atomic spacings, these function blocks are almost microscopically small and virtually weightless. For example, weight of the light telemetry subsystems was reduced from about one ounce to one quarter of an ounce, the weight of the monolithic element to about seven-tenthousandths of an ounce.

As the basis for these molecular electronic subsystems, we have a very substantial knowledge of solid state phenomena developed over the past thirty years. It is simple now to create materials having excessive positive or negative electrical charges and, by placing these materials in physical contact with related materials, to bring about such phenomena as rectification or amplification, as in diodes and transistors. Also, we can readily take advantage of the ability of radiation to cause charge paths to occur in a semiconductor material along which current will flow when the material is irradiated.

Effects of this general type are used in molecular electronic blocks by creating—usually in single crystals—a number of distinct operative domains. The domains border one another at boundaries called interfaces where phenomena different from those occurring inside the molecular domains are initiated.

As a simple example in the element diagrammed in Fig. 3 we see that it is composed of two domains which meet physically at one interface. One of these domains is composed of a resistive material selected and shaped to present a resistance R_1 to the passage of current; the other domain is also resistive, but is so planned that it has a resistance R_2. At the interface, the interaction between domains causes a capacitive effect. Thus, in one tiny element we have a subsystem equivalent to a time-delay circuit.

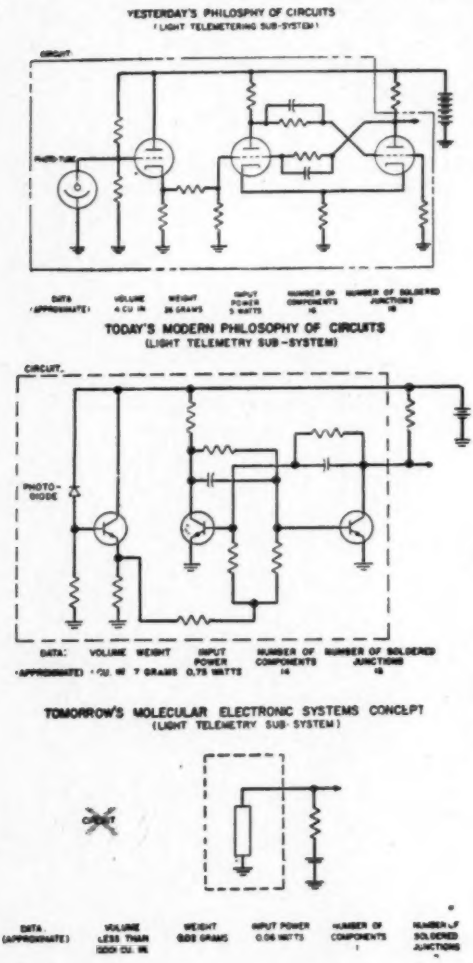


FIG. 2. Schematic drawing of light telemetry subsystems showing extent of circuitry required for systems using (1) electronic tubes, (2) transistors, and (3) molecular electronic element.

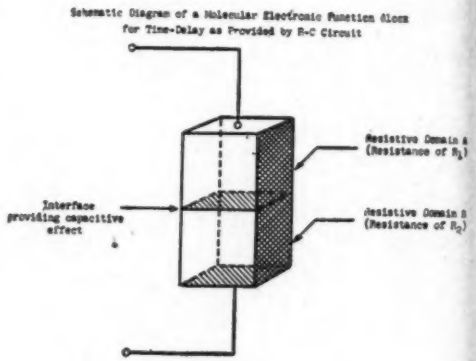

Schematic Diagram of a Molecular Electronic Function Block for Time-Delay as Provided by R-C Circuit
Resistive Domain A (Resistance of R_1)
Interface providing capacitive effect
Resistive Domain B (Resistance of R_2)

FIG. 3. Schematic drawing of function block of two resistive domains and one capacitive interface, whose total effect is that of an RC or time-delay circuit.

Another illustration of the uses of domains and interfaces is a function block designed as an ac-to-dc power supply for transistor circuits. It makes use of the Seebeck effect for the thermoelectric generation of electricity to convert 110-volt alternating current to 9-volt direct current power. In contrast, the conventional circuit, Fig. 4, requires five individual components—a transformer, a diode, and the inductive and capacitive elements making up the LC filter circuit. To accomplish this same purpose with electronic methods, we have a

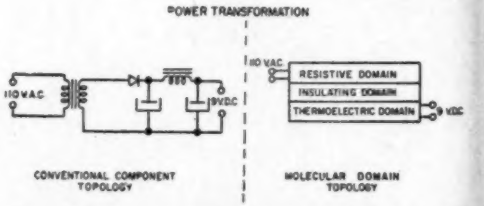


FIG. 4. Schematic drawing of a-c to d-c power supplies showing (1) molecular element with resistive, electrical-insulating, and thermoelectric domains and (2) conventional method using transformer, diode, and filter circuit.

function block comprising three separate domains. When a-c power is applied to the resistive domain, the heat that is generated passes through the domain at the centre—this domain is an electrical but not a thermal insulator—and into the thermoelectric domain where the energy is converted into electrical energy by the Seebeck effect. By proper control over the materials used, we provide the 9-volt d-c output we desire. An interesting aspect of the power supply is that elimination of ripple as an undesirable variation in voltage is inherent since heat flows from the resistive domain to the thermoelectric domain at practically a constant rate.

As these two examples suggest, the concept of molecular electronics makes no use of the traditional circuit-and-component approach to electronics. Instead, the objective is to use our knowledge of the structure of matter to synthesise monolithic function blocks whose arrangement and composition permit each to serve as a substation to perform an electronic function in the control or transformation of energy.

To achieve function blocks with this capability, a number of effects and phenomena of the solid state are available. The only firm limitations on choice are that the effect must not react adversely on system reliability and must lend itself to consistent results when included in a function block. Methods typical of practice so far include : solid state phenomena, such as the Seebeck generation, Peltier cooling, and Hall-effect multiplication ; the use of PN semiconductor junctions arranged to produce a result which would otherwise require numerous individual components ; and when necessary, fabrication of circuit elements within a function block. Although such phenomena will be most often used for the control of electrical signals, they will also be suitable when quantities like electromagnetic radiation, heat, and mechanical displacement are inputs or outputs.

The design of a subsystem begins with the designer's analysis of the requirements of the system, to establish the functions to be performed by the function block. After logic processes are determined and suitable physical effects settled upon, a topologist—a mathematician who works with shapes—determines the structure of the block by designing, on paper, the arrangements of domains and interfaces that is to control the flow of energy in the block. The block is then produced by the materials engineers who use germanium and silicon as the basic semiconductor materials.

In producing these blocks we do not assemble them from various tiny components. Rather, we start with a basic semiconductor wafer and produce the necessary domains and interfaces by techniques used in the production of conventional semiconductor devices, including diffusion, plating, electron beam machining, etching, cutting, radiation, alloying and photographic processes. Although the function block so produced can now perform its function, additional processing steps are required to encapsulate the block, protect it against shock and vibration, and make it stable under the conditions of temperature and radiation it will encounter.

One important illustration of the contributions made by materials scientists is the development of a method for the rapid production of semiconductor crystals in a form that requires no removal of material to make them into suitable wafers for use as transistors or as the basic elements of molecular electronic elements. This is the dendrite process in which germanium crystals in the form of ribbons about one-eighth of an inch wide and a few thousandths of an inch thick, are produced by drawing them from a molten mass.

The dendritic method is essentially a continuous process in which the germanium ribbon grows at the rate of 6 to 12 inches per minute and in the precise direction of crystal growth we require for application.

Now, although this dendritic method has immediate usefulness in molecular electronics today, we are confident that its greatest significance is its ability to bring about a number of new processes for producing fundamental blocks. We are now most interested in a recent modification which makes it possible and practical to carry out diffusion, plating, and evaporation processes directly on the crystal as it grows from the furnace melt. With this technique, we are able to create semiconductor devices ready for the attachment of leads. One of the first uses has been to grow transistors in the form of a long germanium crystal.

When the ribbon-like crystals are cut into segments, only simple processing is needed to produce transistors at a yield very near 100%. By this method we have produced lengths of ribbon along which small multiple-junction subsystems are distributed, Fig. 5. Since these ribbons can be easily processed to become a long series of tiny amplifiers, it is not at all facetious to say that this ribbon can be snipped into lengths to give us amplifiers of whatever gain we desire.

A more recent and extremely significant achievement resulting from our research is that we have now discovered how to grow multizoned

FIG. 5. Ribbon bearing multiple-junction systems on germanium crystal produced by dendrite process.

crystals as dendrites, directly from the furnace melt. We regard this development as a major event in new technology of molecular electronics. It makes available to us basic building blocks having at least three layers of zones and two interfaces. Thus it will no longer be necessary to perform many operations to create multizone elements.

In considering the implications of this basic method for crystal growth, one most interesting possibility is that it will prove practical to combine our ability to grow multizoned crystals with our ability to perform operations on the crystal at the time it is growing in the furnace. Admittedly, to achieve near-automatic production of semiconductor devices and molecular electronic function blocks is a long-range objective, but it is probable that we will eventually be able to "grow" from a pool of molten semiconductor materials some items of electronic equipment that today are of the order of complexity of radio receivers and amplifiers.

Although there was a 20-year interval between the invention of the vacuum tube and its first significant application, and an 8-year interval between the development of the transistor and its first uses, it is almost certain that no such delay is likely for molecular electronics. It is very likely that in three to five years we will see the molecular electronic concept widely applied in air space electronic systems for such important applications as telemetering, fire control guidance, communications, etc.

OBITUARY

SIR K. S. KRISHNAN

WE deeply regret to record the death of Sir K. S. Krishnan, Director, National Physical Laboratory, New Delhi, on Wednesday, the 14th of June, 1961.

Krishnan was born on the 4th December, 1898. He graduated from the Madras Christian College and later migrated to the University College of Science at Calcutta where he studied for two years. Sir C. V. Raman chose Krishnan for a position as Research Assistant in his laboratory and sponsored his promotion to the various positions held by him in later years; Reader in Physics at the Dacca University; the Mahendra Lal Sircar Professor at Calcutta in 1933 and University Professor of Physics at Allahabad in 1942. Sir C. V. Raman also proposed him for the Fellowship of the Royal Society to which body he was elected in 1940. Krishnan was appointed as the first Director of the National Physical Laboratory at New Delhi in 1947. This position he held till his death.

In his earlier years, Krishnan was closely associated with Sir C. V. Raman in his investigations. After the discovery by Sir C. V. Raman of the effect known by his name, Krishnan and later on, other workers also in the laboratory, assisted in following up the consequences of that discovery. At about the same time, systematic researches on magnecrystallic action were initiated by Sir C. V. Raman and were first carried on by Bhagavantam at Calcutta. These were subsequently continued by Krishnan at the Dacca University and formed the basis of his election to the Fellowship of the Royal Society.

PREVENTION OF FLOWERING IN SUGARCANE

R. R. PANJE AND T. RAJA RAO

Indian Institute of Sugarcane Research, Lucknow

FLOWERING in commercial sugarcane crops is undesirable; with floral initiation, vegetative growth of the apical meristem ceases; the leaf-crown dwindles into short-blades, thus diminishing its fodder value. Later, the top portion of the cane becomes pithy and, due to the loss of apical dominance, develops side shoots. Finally there is a gradual drop in sugar content. Non-flowered canes are therefore preferred both by the grower and the sugar manufacturer.

In varietal selection, the tendency to blossom is a negative attribute. However, there are some good commercial varieties, which flower somewhat freely; if the flowering of these varieties as crops can be prevented, these varieties may become more profitable or acceptable than they are now.

Since the switch-over of the apical meristem from the vegetative to the reproductive phase is caused by hormonal changes and these in turn are brought about by the perception of the photoperiodic stimulus by the plant, flowering can presumably be prevented by an appropriate interference with one or other of the links in the process of floral initiation; *i.e.*, either (i) by avoiding or circumventing the stimulus itself, *viz.*, the photoperiod; (ii) by preventing the perception of the stimulus by the plant, or (iii) by the action of suitable chemicals on the pre-flowering metabolic changes. Studies of Cajlachjan (1936, 1945), Borthwick and Parker (1938) Withrow *et al.* (1943), Hamner and Naylor (1939), Greulach (1942) and others have clearly indicated that the green leaves are the organs of perception in this case. Since the use of chemicals and interference with the photoperiod are *prima facie* not likely to be commercially acceptable, efforts were made in our experiments in the direction of third alternative, namely, elimination of the perception mechanism through defoliation of plants.

It was found by periodically dissecting the leaf spindle that under Lucknow conditions, floral initiation takes place in early October in the majority of cases. It was presumed from this that the critical photoperiod, its perception by the plant and the connected metabolic changes in the plant would very likely occur in the 2 or 3 weeks preceding this date; accordingly, defoliation was done in different treatments in successive weeks from end-August to early-October, employing two heavily-flowering varieties, Co. 1207 and Co. 1062. In the former, about 450 stalks were treated; in the latter about 850. Defoliation was effected by cutting off the blades at the dewlap.

TABLE I

Defoliated on			Percentage of flowering and short-blade stalks at harvest		
			Spindle cluster including the topmost dewlap blade removed		Spindle cluster and three leaves removed
			Co. 1062	Co. 1207	Co. 1207
August	12	..	55·3	..	..
	27	..	54·5	..	..
September	2	..	8·7	..	..
	5	..	..	26·7	..
	8–9	..	5·0	20·2	15·2
	14–15	..	1·7	4·3	2·6
	20	..	2·9	..	..
	23	..	..	8·8	0·9
	26	..	2·4	..	..
October	2	..	15·7	..	..
	8	..	46·6	..	..
Control		..	53·0	55·2	55·2

The results (Table I) indicate that defoliation from 14th to 26th September has almost entirely suppressed flowering; the treated stalks remained vegetative, and provided the normal full leaf-crowns at harvest.

Further the treatments show a clear gradient in the suppression effect, the percentage of flowering-*cum*-short-blade stalks to total number of stalks falling with the defoliations of successive weeks from end-August up to the 3rd and 4th weeks of September when the maximum suppression occurred; later defoliations were progressively ineffective. The third observation is that the critical defoliation date is the same for both the varieties.

Borthwick and Parker (1940), Gerhard (1940), Ullrich (1939), Naylor (1941), Moskov (1937) and others have inferred from their studies that young expanding leaves of plants are insensitive to the photoperiodic stimulus, while the sensitivity of the fully unfurled leaves depends on the age of the leaf, the youngest being the most sensitive and the oldest mature leaves being relatively insensitive. In our experiments on Co. 1207, two degrees of defoliation were tried: (i) removal of spindle cluster including the blade of the topmost dewlap and (ii) removal of spindle cluster and three more blades below it. The results (Table I) suggest that the

young expanding blades of the spindle cluster *plus* the blade of the topmost dewlap constitute the principal sensitive organ for the perception of photoperiodic stimulus; the sensitivity however extends to some extent to the next lower three or four leaves also. Apparently, there is a sensitivity gradient in the leaves; this is being investigated in further experiments.

The results indicate a clear possibility of keeping sugarcane crops in the vegetative condition by adopting a cultural practice which is obviously adoptable under Indian conditions, even though in Hawaii it has not been found practicable on a plantation scale.

1. Borthwick, H. A. and Parker, M. W., *Bot. Gaz.*, 1932, **100**, 245.
2. – and –, *Ibid.*, 1940, **101**, 806.
3. Cajlachjan, M. C., *Compt. Rend.* (*Dok*) *Acad. Sci. U.R.S.S.*, 1936, **4**, 79.
4. –, *Ibid.*, 1945, **47**, 220.
5. Gerhard, E., *J. Landw.*, 1940, **87**, 161.
6. Greulach, V. A., *Bot. Gaz.*, 1942, **103**, 698.
7. Hamner, K. C. and Naylor, A. W., *Ibid.*, 1939, **100**, 853.
8. Moskov, B. S., *Bull. Appl. Bot. Gen. and Pl. Breed. Ser. A. Supplement*, 1937, No. 21, p. 145.
9. Naylor, A. W., *Ber. D. Bot. Ges.*, 1941, **103**, 342.
10. Ullrich, H., *Ibid.*, 1939, **57**, 40.
11. Withrow, A. P., Withrow, R. B. and Biebel, J. P., *Plant Physiol.*, 1943, **18**, 294.

INTERNATIONAL CONTROL OF INVESTIGATIONS OF RARE METEORITES

IN recent years the study of meteorites has rapidly increased and, in the hands of investigators such as Urey, Anders, Wiik, Vinogradov and others, has thrown much light on the composition and origin of the solar system and of the planets. Last year, through the work of Mason on hydrous silicates in meteorites, interest has concentrated on the rarest form of meteorites, those which contain carbonaceous material. It follows from Mason's results, as well as from the earlier analyses of material by G. Mueller, that carbonaceous meteorites, unlike all other types, had never been subjected to high temperatures since their formation and that they might well contain samples of the raw materials from which life may have been formed on larger planets. On March 16, this hypothesis was given a new turn by the announcement at the meeting of the New York Academy of Sciences that Prof. B. Nagy, Dr. W. Meinschein and Dr. Hennessy had, by using mass spectroscopic and X-ray methods, found in the carbonaceous material from the meteorite which fell near Orgeuil in France on May 14, 1864, paraffinoid hydrocarbons characteristic of living organisms and hence had, in the opinions of these investigators, provided proof for the existence of life on its presumed parent body. This view is unlikely to go unchallenged, but whatever the final consensus of opinion, the crucial importance of this study of the carbonaceous meteorites is now evident (*see also Science Notes*, p. 245).

The great publicity deservedly given to these observations and deductions has focused the attention of scientists in many countries on the carbonaceous meteorites. Paradoxically, the result may well be, unless appropriate steps are taken in time, to bring the researches to a rapid end by destroying the irreplaceable material on which they are based. There is known to be only some 30 kg. of well-attested carbonaceous meteorites in museums. More, but not much more, may be in the hands of dealers or may be brought to light in other ways. Already these rare bodies are being examined in a dozen or more laboratories, each with a different objective and by methods which render the material useless for further study. This can only result in the exhaustion of the stock unless prompt measures are taken to ensure international co-operation similar to that in the various sections of the International Geophysical Year in the analysis of meteorites by different but complementary methods. The appropriate body for this is clearly the Committee on Space Research of the International Council of Scientific Unions, which, by a slight extension of its terms of reference, might cover bodies coming in from outer space as well as those going out into it. It is hoped that at the forthcoming meeting of the Committee at Florence, the matter can be discussed and appropriate measures taken in time to secure that the maximum of information is obtained from meteorties with the minimum of destruction. —(*Nature*, 1961, 189, 967.)

THE DEVELOPMENT AND THE FUTURE OF PHYSICS

THE exciting prospects of physics was the theme of the first Presidential Address to the recently amalgamated Institute of Physics and Physical Society given by the President Sir John Cockcroft in London on 2 May.

In it he made a rapid survey of recent and likely developmets in solid state physics, mentioning among other things transistors, tunnel diodes, semiconductors, optical masers, modern electronic valves and artificial diamonds. "These, perhaps" he remarked "are a sufficient number of examples to show the creative power of physics in one single field".

Atomic energy development, he reminded his audience, has provided another major demand for physicists, and their work ranged from determining nuclear data to the prediction of kinetic behaviour of reactors and the study of radiation damage. Then there was the important group of physicists engaged in plasma physics research. Sir John's view was that controlled fusion research is likely to remain in the basic research stage for some considerable time yet.

Studies of nuclear structure, the President thought, were likely to have at least ten to twenty further years of interesting life. Space research he thought seemed likely to outstrip nuclear physics research both in glamour and expense in the U.S. and U.S.S.R. He thought it very remarkable how the advent of rockets, with their prestige and military implications, had brought the once greatly neglected field of astronomy into the full limelight. The military and disarmament interest in the detection of underground explosions has had a similar effect on the earth sciences and seismology in particular. Molecular biology and biophysics, though employing few physicists at present, were already becoming of major importance ; it is a field in which physicists can have a powerful influence.

Sir John stressed the importance of international co-operative efforts in providing the expensive equipment now needed for fundamental research in physics such as bubble chambers, particle accelerators, large computers and equipment for space research.

RAMAN SPECTRUM OF DEUTERATED METHANE (CD_4)

IN the latest communication in the series of contributions from the McLennan Laboratory, University of Toronto, on high-resolution studies of Raman Spectra, Olafson, Thomas and Welsh have presented recent results on the spectrum of methane-d_4 (CD_4). (*Canadian Jour. Phy.*, 1961, **39**, 419.)

Heavy methane, like ordinary methane (CH_4), is a spherical top molecule (point-group T_d), and has four normal modes of vibration, one totally symmetric $\nu_1(a_1)$, one doubly degenerate $\nu_2(e)$, and two triply degenerate $\nu_3(f_2)$ and $\nu_4(f_2)$, all of which are active in the Raman effect. In the present investigation Raman spectrum photographs taken with a newly developed grating spectrograph of high light-power, and having a reciprocal linear dispersion of 6 cm.$^{-1}$ per mm. at 4358 A, and a practical resolving power of ~0·4 cm.$^{-1}$, have enabled precision analysis of the rotational structure of the ν_2 and ν_3 bands to be effected leading to a more accurate evaluation of the constants involved.

The Raman tube, 1·1 metre long with a volume of 1·7 litre, was equipped with a multiple reflection mirror system, and was irradiated by four hairpin-shaped mercury arcs with water-cooled electrodes operated at 17 amp. The Raman tube was filled with high purity CD_4 gas to a pressure of 1 atm.

The exposure time for photographing the weak ν_2 band excited by 4358, varied from 90 to 115 hours. 84 lines were measured in the shift range 950-1330 cm.$^{-1}$ The permissible rotational transitions followed the selection rules $\Delta J = 0, \pm 1, \pm 2$. Accordingly there should be five branches O, P, Q, R and S. However, analysis showed that the rotational levels of the upper vibrational state were each split into two, an upper and a lower level. Thus out of the ten possible branches, seven were observed in the ν_2 band.

Photographs of the ν_3 band were obtained both with the line 4047 and the line 4358, the exposure time varying from 12 to 64 hours. In this band the rotational levels of the upper vibrational state are split by the coriolis interaction of the rotational and vibrational motions into three sub-levels. Transitions are allowed to all three sub-levels in Raman scattering ; the selection rule $\Delta J = 0, \pm 1, \pm 2$, thus gives 15 bands in the rotational structure. 202 lines were measured in the shift region 1950-2500 cm.$^{-1}$ 60 of these lines in the region 1950-2115 cm.$^{-1}$ belonged to the ν_1, $2\nu_4$, and $\nu_2 + \nu_4$ bands. The remaining 142 lines

in the region 2110-2500 cm.$^{-1}$ could be analysed into 13 of the possible 15 branches of the ν_3 band.

From these analyses the length of the C-D bond could be calculated. The effective bond length, r_0 (C-D), was found to be 1·09181 ± 0·00029 A. The corresponding value for methane, r_0 (C-H), is 1·09403 ± 0·00016.

EVOLUTION AS A TEST FOR ETHICS*

TWENTY years ago, Professor Waddington wrote a book on "Science and Ethics" to which his present book *The Ethical Animal* is a sequel. He does not try, as some critics have stated, to derive ethics from a study of evolution. He believes, however, that evolution helps us to judge between different ethical systems. Here are his exact words (p. 30) "We have first to try to ascertain the general character of human evolution or indeed, of animal evolution as a whole. We have then to enquire, of any particular ethical belief which comes to our attention, how effective it is in mediating this empirically ascertained course of evolutionary change."

The same ideal was expressed over three centuries ago, by Chapman in Clermont's speech in "The Revenge of Bussy d' Ambois", who held

> "That in this one thing all the discipline
> Of manners and of manhood is contained;
> A man to join himself to the universe
> In its main sway, and make, in all things fit
> One with that All, and go on, round as it."

I think that this is a noble fallacy, but yet a fallacy.

I do not think we know enough about the universe, or even about evolution on our planet, to use our knowledge as a test of ethical systems. It is possible that on the basis of messages received from the artificial satellite circling round our planet, the inhabitants of one of the planets of Tau Ceti or Delta Pavoins are at present saying something like this about our species. "The inhabitants of G_1 17898 III have now reached the stage of technical knowledge when they will be able to exterminate one another completely. Judging from their past behaviour it is certain that they will do this. On all the 7319 planets known to us where living beings descended from carnivorous ancestors learned to promote nuclear fission they killed one another. The best hope for the survival of such a species is the appearance of a series of tyrants who massacre in the name of some religious belief. This checks the growth of physical knowledge. Unfortunately for the species now dominating the planet in question it did not produce enough men of the type of Charlemagne and Mahmoud of Ghazni, and is in consequence now doomed. From a broader point of view this is a welcome prospect, as some herbivorous species devoid of fighting instincts may possibly evolve a high brain organization on this planet in the next hundred million years".

I do not happen to believe this, but I think it entirely possible that it may be true. Waddington's mind seems to move in the rather narrow set of intellectual grooves fashionable in modern Britain. Thus on page 35 he writes of philosophy as "understood by the most influential modern school, the followers of the later Wittgenstein". This school is not very influential compared with many older (and in the reviewer's opinion more intellectually coherent) philosophies such as Thomism and Vedantism. And its influence is negligible compared with that of Marxism as developed by Lenin, which is a modern school. Waddington may believe that Marxism is false, but if he thinks it is less influential than the school of Wittgenstein, he is blind to historical fact.

I do not even believe in Waddington's account of how man became an ethical animal. I think our ancestors underwent a rather sudden change of habitat, perhaps a "fall" from trees, which rendered their ancestral instincts incompatible with survival. They lost most of them, which enabled them to start technology; but to perform the functions of instincts they had to produce ethics. The human needs for ethics may be a temporary and unhappy phase in evolution.

In spite of all these criticisms the book contains some interesting bits of thought, and I hope that it will stimulate others to more constructive criticism than my own. I hope it will be widely read in India. But if so I trust that nobody will say "The teaching of modern evolutionary biology, as Waddington has shown, is....". When we have studied evolution for two thousand years we may be able to use it as an ethical criterion. Or we may not.

J. B. S. HALDANE

* *The Ethical Animal*. By C. H. Waddington. (George Allen and Unwin, Ruskin House, 40, Museum Street, London, W.C. 1). 1960. Pp. 230. Price 25 *sh.*

LETTERS TO THE EDITOR

ABSORPTION CROSS-SECTIONS FOR THE NUCLEAR SCATTERING OF HIGH ENERGY NUCLEONS

In a previous note[1] a characteristic nuclear transparency curve was shown to exist from the experimental values of σ_a at 305 MeV, 860 MeV and 1·4 BeV. Recently extensive experimental data on absorption cross-sections are available at 140 MeV,[2] 300 MeV,[3] 350 MeV,[4] 650 MeV,[5] 765 MeV,[6] 860 MeV,[7] 895 MeV,[8] 900 MeV,[8] 910 MeV,[9] 970 MeV,[9] 1·4 BeV,[10] 3·6 BeV[11] and 4·0 Bev[12] for Be, C, Al, Cu, Sn, Pb, Bi and U.

In the present investigation experimental values of σ_a, at these energies, have been used and γ_2 has been calculated for each element from the experimental values of σ_{pp} and σ_{np} as given by Chen *et al.*[13] The plot of $\sigma_a/2\pi A^{2/3}$ with the corresponding errors, against the independent parameter γ_2, is shown in Fig. 1. It is clear that all the points approximately lie on a smooth curve confirming our original

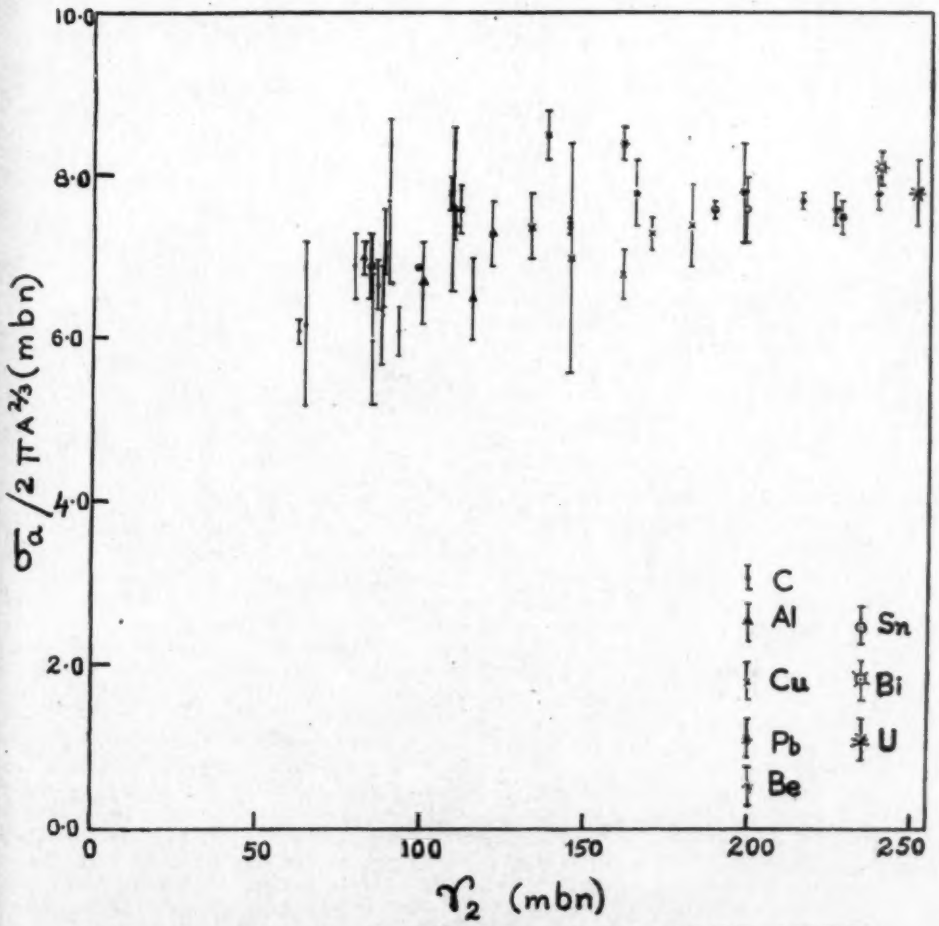


FIG. 1. Study of absorption cross-sections for energies ranging between 140 MeV and 4·0 BeV.

assumption that there exists a characteristic transparency curve. The small deviations may be attributed to the systematic errors in the experimental values of σ_a and the invalidity of the concept of a characteristic nuclear density distribution for heavy elements. We have recently analysed the nuclear scattering of high energy nucleons for middle heavy elements and have noted that a characteristic nuclear density distribution also exists. The details of this work will be published shortly.

Department of Physics, Bhavan's College, Andheri, Bombay-58, *April* 25, 1961.

G. Z. SHAH.
B. M. THAKER.

1. Gatha, K. M. and Shah, G. Z., *Curr. Sci.*, 1957, **26**, 387.
2. Voss and Wilson, *Proc. Roy. Soc.*, 1956, **41 A**, 236.
3. Ball, B., *U.C.R.L.* (Report 1938, unpublished).
4. Ashmore, A., Mather, D. S. and Sen, S. K., *Proc. Phys. Soc.*, 1958, **71**, 552.
5. Maskalev, V. I. and Gavrilovskii, B. V., *Doklady Akad. Nauk. S.S S.R.*, 1956, **110**, 972.
6. Booth, N. E., Ledley, B., Walker, D. and White, D. H., *Proc. Phys. Soc.*, 1958, **71**, 293.
7. Chen, F. F., Leavitt, C. P. and Shapiro, A. M., *Phys. Rev.*, 1955, **99**, 857.
8. Booth, N. E., Ledley, B., Walker, D. and White, D. H., *Proc. Phys. Soc.*, 1957, **70 A**, 209.
9. Batty, C. J., Lock, W. O. and March, P. V., *Ibid.*, 1959, **73**, 100.
10. Coor, T., Hill, D. A., Hornyak, W. F., Smith, L. W. and Show, G., *Phys. Rev.*, 1955, **98**, 1369.
11. Barrett, P. H., *Ibid.*, 1959, **114**, 1374.
12. Sinha, M. S. and Das, N. C., *Ibid.*, 1957, **105**, 1587.
13. Chen, F. F., Leavitt, C. P. and Shapiro, A. M., *Ibid.*, 1956, **103**, 211.

ELECTRONIC TRANSITION MOMENT VARIATION AND VIBRATIONAL TEMPERATURE

LEARNER AND GAYDON[1] have recently pointed out that rotational temperature of a band system is affected by the vibration-rotation interaction. James[2] has pointed out that such interaction is closely related to the effect of the variation of R_e, the electronic transition moment, with the internuclear separation r, and that a neglect of this interaction can lead to apparently abnormal temperatures. In fact, while studying the variation of R_e with r in BeO ($B^1\Sigma \rightarrow X^1\Sigma$) band system, Sreedhara Murthy[3] has made a specific point that in the derivation of temperature from vibrational intensity distribution, account need be taken of the variation of R_e with r. The paper describes the method of estimating the vibrational temperature of BeO (blue-green) system by incorporating the effect of R_e variation.

DERIVATIONAL PROCEDURE

(*a*) If R_e is considered not to vary with r, i.e., R_e is constant, we have the following expression from the vibrational sum rule, assuming Maxwell-Boltzmann distribution at a temperature T:

$$\sum_{v''} \frac{I}{\nu^4} = AN'_{v'} (P_{v',v_0} + P_{v',v_1} + P_{v',v_2} + \cdots)$$

$$= AN'_{v'} = AN_0 e^{-E_{v'}/kT}$$

where A = constant (1)

If a graphical plot of $\log_{10} \sum_{v''} I/\nu^4$ against $E_{v'}$ is made it should give a straight line, the slope of which yields the effective vibrational temperature.

(*b*) With R_e as a variable in r, the expression (1) modifies to

$$\sum_{v''} \frac{I}{\nu^4} = AN_{v'} P_{00} \left(\frac{P_{v',v_0}}{P_{00}} + \frac{P_{v',v_1}}{P_{00}} + \cdots \right)$$

$$= AN_{v'} P_{00} \sum_{v''} \frac{P_{v',v''}}{P_{00}}$$

or,

$$\frac{\sum_{v''} \frac{I}{\nu^4}}{\sum_{v''} \frac{P_{v',v''}}{P_{00}}} = AN_{v'} P_{00} e^{-E_{v'}/kT}. \quad (2)$$

The plot of

$$\log_{10} \frac{\sum_{v''} \frac{I}{\nu^4}}{\sum_{v''} \frac{P_{v',v''}}{P_{00}}}$$

against $E_{v'}$ should give a straight line, the slope of which again yields the vibrational temperature.

Tawde and Sreedhara Murthy[4] have obtained the quantitative integrated intensity data on the bands of BeO ($B \rightarrow X$) system excited in a steady carbon arc source at atmospheric pressure by accurate method of photographic photometry, and have derived the I/ν^4 values of the bands therein. The same authors have used the overlap integrals[5] and r-centroids[6] and given a set of smoothed transition probabilities, $P_{v'v''}/P_{00}$ taking into account the R_e variation[4] for this band system. These values have been used here for the evaluation of the effective vibrational temperature. The molecular constants needed for this evaluation are taken from the compilation of Herzberg.[7] In each case accurate determination of temperature is made by using the least square technique of fitting the straight line graph.

Results and Discussion

The temperatures derived are recorded below :

(a) With R_e as a constant : $T = 4840°$ K.

(b) With R_e as a variable in r : $T = 4000°$ K.

Estimate of percentage error in the result is of the same order in both the cases. The values, in general, are in accord with the expectations from the postulate of a temperature gradient in the carbon arc extending from the core to the surrounding flame zones[8–10] and "optimum temperature" of the molecule.[11] The results further indicate that the inclusion of R_e variation is a significant factor to be considered in the derivation of temperature of a source from band intensity studies, a point that has so far not been well emphasised. The trend is generally to bring down the excessive vibrational temperature values and this in the right direction.

One of the authors (N. S. M.) is grateful to the Ministry of Education, Government of India, for the award of a Senior Research Training Scholarship.

Dept. of Physics, N. R. Tawde.
Karnatak University, N. Sreedhara Murthy.*
Dharwar, *April* 28, 1961.

* Now, Post-Doctoral Senior Research Fellow of the National Institute of Sciences of India ; on leave from the Central College, Bangalore.

1. Learner, R. C. M. and Gaydon, A. G., *Nature*, London, **1959**, **183**, 242.
2. James, T. C., *J. Chem. Phys.*, **1960**, **32**, 1770.
3. Sreedhara Murthy, N., *Ph.D. Thesis*, Karnatak University, Dharwar, 1958.
4. Tawde, N. R. and Sreedhara Murthy, N., *Proc. Ind. Acad. Sci.*, 1960, **51**, 219.
5. — and —, *Physica*, 1959, **25**, 610.
6. — and —, *Bull. Soc. Roy. Sc. Liège*, 1960, **29**, 325.
7. Herzberg, G., *Spectra of Diatomic Molecules*, 2nd Edition, D. Van Nostrand Co., New York, 1950, p. 509.
8. Tawde, N. R. and Trivedi, S. A., *Proc. Phy. Soc., (London)*, 1939, **51**, 733.
9. — and Hussain, A. G., *Bom. Univ. Jour.*, 1949, **17**, 12.
10. —, *Phys. Rev.*, 1946, **70**, 432.
11. Coheur F. P. and Coheur, P. M., *Ibid.*, 1946, **69**, 240.

THE EFFECT OF SIXTH DEGREE CUBIC FIELD ON RARE-EARTH IONS IN CRYSTALS

Magnetic measurements (Jackson, 1935) on powder crystals of octahydrated sulphates of Neodymium and Erbium between the range 290° and 14° K. show that the strength of the cubic field in $Er_2(SO_4)_3.8H_2O$ is very small compared to that in $Nd_2(SO_4)_3.8H_2O$. This result is rather surprising. As the salts are isomorphous and their molecular volumes cannot differ greatly one would expect the crystalline fields in them to be similar, so far as strength and symmetry are concerned.

In order to get an insight into the above-mentioned discrepancy we have measured the magnetic anisotropy and the principal moments of $Er_2(SO_4)_3.8H_2O$, single crystals from 300° to 80° K. by well-known methods (Krishnan *et al.*, 1939, Bose, 1947). The anisotropy is 0·10 for $Er_2(SO_4)_3.8H_2O$ and 0·11 for $Nd_2(SO_4)_3.8H_2O$ at 300° K. Thus the anisotropy is by no means small. Each rare-earth ion in the crystal has at least this amount of anisotropy ; probably the anisotropy is more, since in general, there will be more than one unit in the unit cell of the crystals and all these units will not be oriented parallel to one another.

Hence the problem of explaining the observed magnetic properties of these crystals in terms of the magnitude and symmetry of the field associated with each ion, and the orientation of the field axes of these ions relative to one another, becomes extremely complicated.

It is however fortunate that in the rare-earth ion salts, the mean of the three principal moments of the crystals is determined to a first approximation by the cubic part of the field (Mookherji, 1949), so that one may obtain from the observed mean moments a general estimate of the cubic field, and from the anisotropy the non-cubic field. Thus we find that the mean moments of this crystal can be represented to a first approximation by a single suitable cubic field ($a = 0·0135$ cm.$^{-1}$) which is almost the same at all temperatures in the range studied as shown in Table I.

Table I

Temperature °K.	300	200	140	100
$\mu_{obs.}$	9·48	9·25	9·27	9·33
$\mu_{cal.}$	9·61	9·62	9·60	9·68

Calculated values ($\mu_{cal.}$) were obtained by using the expression as given by Spedding (1937) in which the cubic field used is regarded as of the fourth degree. According to Kynch (1937) the splittings of the energy levels of Nd^{+++} and Er^{+++} and hence the magnetic moments depend on whether the cubic field involves only the fourth degree terms or in addition sixth degree terms also. In case of Er^{+++} the energy levels with the fourth degree field alone are 0, 19 38, 85 and 89 cm.$^{-1}$ while for the combined field they are 0, 19, 27, 85 and 85·6 cm.$^{-1}$

At low temperature the moment values of the salts will depend mainly on the lowest levels. As is seen the inclusion of the sixth degree field depresses energetically one of the levels while the other two come very close.

Thus though the mean magnetic moments can be explained approximately on the basis of a single suitable cubic field of the fourth degree, the absolute magnitude of the fourth degree field estimated in this way will not be correct as the sixth degree terms of the cubic field influence the moments and the magnitudes of the fourth degree, and sixth degree terms in these crystals are not known.

Work is in progress with fields of tetragonal symmetry to get a fit with magnetic anisotropy and its variations with temperature.

Details will be published elsewhere.

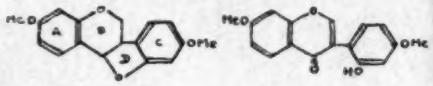
Physical Laboratories, A. MOOKHERJI.
Agra College, Agra (India), D. NEOGY.
May 9, 1961.

1. Bose, A., *Ind. Jour. Phys.*, 1947, **21**, 275.
2. Jackson, L. C., *Proc. Phys. Soc. London*, 1935, **47**, 1027.
3. Krishnan, Mookherji and Bose, *Philos. Trans.*, 1939, **238**, 125.
4. Kynch, *Trans. Farad. Soc.*, 1937, **33**, 1402.
5. Mookherji, A., *Ind. Jour. Phys.*, 1949, **23**, 309, 410.
6. Spedding, F. H., *J. Chem. Phys*, 1937, **5**, 316.

SYNTHESIS OF A RACEMATE OF HOMOPTEROCARPIN

PTEROCARPIN and homopterocarpin are two tetracyclic compounds[1] related to isoflavones but so far no successful attempts have been made to synthesise them. In the course of exploratory work for establishing interrelationship among isoflavonoids, it has now been possible to synthesise homopterocarpin (I) using 7 : 4′-dimethoxy-2′-hydroxy isoflavone ($C_{17}H_{14}O_5$) (II) (m.p. 183–84°) as the main intermediate. This isoflavone has been prepared using special methods.

Among the number of methods investigated for reducing the oxygen ring and constructing the D ring of the homopterocarpin, the use of sodium borohydride has been most successful. Reduction of both the double bond and the carbonyl group takes place with this reagent. In this respect we confirm the findings of Miyano and Matsui[2] on the reduction of dehydrorotenone and related compounds. We have observed that the reduction of the isoflavone (II) with sodium borohydride in tetrahydrofuran-alcohol medium yields directly a racemic mixture of homopterocarpin (m.p. 129–30°) almost in quantitative yield. The structure was established by comparison with a natural sample of (−) homopterocarpin using ultra-violet and infra-red spectra both taken in chloroform which were found to be identical. The method seems to be of general utility and its use is being extended for the synthesis of related compounds.



I II

FIG. 1

Satisfactory analysis has been obtained for compounds mentioned in this communication.

We convey our thanks to Dr. W. B. Whalley for providing us with a specimen of natural homopterocarpin.

Department of Chemistry, K. AGHORAMURTHY.
University of Delhi, A. S. KUKLA.
Delhi-6, *May* 12, 1961. T. R. SESHADRI.

1. McGookin, Robertson and Whalley, *J.C.S.*, 1940, 780; 1954, 1440.
2. Miyano and Matsui, *Chem. Ber.*, 1958, **91**, 2044.

ENHANCED REDUCTION EFFICIENCY OF SODIUM BOROHYDRIDE IN THE PRESENCE OF TITANIUM TETRACHLORIDE

BROWN AND SUBBA RAO[1,2] reported that esters undergo rapid reduction even under mild conditions with sodium borohydride in the presence of certain polyvalent metal halides. The system $NaBH_4$–$AlCl_3$ was examined in detail regarding the reducing action on several organic functional groups, while the system $NaBH_4$–$TiCl_4$ was tried only for the reduction of esters. As the latter exhibited certain peculiarities, its full scope has now been investigated.

The procedure adopted in the reduction studies was quite simple. First the reagent was prepared by mixing diglyme solutions (1·0 M) of $NaBH_4$ and $TiCl_4$ in the ratio of 4 : 1. Then to the cooled and stirred reagent (present in excess), the compound to be reduced was added slowly either by itself or in diglyme solution. After 3 hours' reaction at room temperature the reaction mixture was hydrolysed with dil. acid and the reduction product isolated in the usual way.

Thus, carrying out reductions on 10–50 m. mole scale, the following compounds have been reduced and the corresponding reduction products isolated in 70–90% yield :

m-Chloro-*p*-methoxy methyl benzoate → *m*-chloro-*p*-methoxy benzyl alcohol.
Methyl crotonate → Crotonyl alcohol.
m-Methoxy benzoic acid → *m*-methoxy benzyl alcohol.
p-Nitrobenzoic acid → Mixture of products having nitro-group reduced to varying stages and acid group reduced to alcohol.
Crotonic, oleic and cinnamic acids → Corresponding alcohols, also hydroborated at the double bond.
Benzamide, lauramide → Benzamide, lauramide (salt formed but regenerated on hydrolysis).
Benzoyl chloride, *n*-butyryl chloride → Corresponding alcohols.
Diethyl phthalate, diethyl adipate → Corresponding diols.
Phthalic anhydride → Corresponding diol.
Succinic anhydride → Incomplete reaction.
Benzonitrile, acetonitrile → Corresponding amines (V. slow).
Nitrobenzene → Azobenzene, hydrazobenzene and small amounts of phenylhydroxylamine.
Cyclohexene and hexene-1 → Corresponding organoborane.

It is clear that this reagent $NaBH_4$–$TiCl_4$, unlike the selective yet powerful $NaBH_4$–$AlCl_3$, has no selectivity and behaves more like lithium aluminium hydride by reducing practically all common organic functional groups. The very mild and selective reducing agent, $NaBH_4$, can thus be transformed to a powerful reducing agent by the addition of equivalent amounts of $TiCl_4$ and could be used where a strong reducing and hydroborating agent is needed.

National Chem. Lab., B. C. Subba Rao.
Poona-8, *April* 28, 1961.

1. Brown, H. C. and Subba Rao, B. C., *J. Am. Chem. Soc.*, 1955, **77**, 3164.
2. — and —, *Ibid.*, 1956, **78**, 2584.

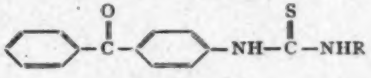
SYNTHESIS OF THIOUREIDO-BENZOPHENONES

Benzophenone has a weak anticonvulsant effect.[1] Aminoketones show weak local anæsthetic properties. Several organic compounds have been found to afford considerable prophylactic protection against lethal doses of Rontgen rays. Among them are thiourea and *p*-aminopropiophenone.[2] Thiourea was the first drug to be used in human thyrotoxicosis before thiouracil became available.[3] It is found that)N—CS—N(grouping is responsible for goitrogenic behaviour. With these views in mind, it was of interest to synthesize thioureas having benzophenone as a substituent on nitrogen of thioureido system for studying their goitrogenic effect. Compounds synthesized are described in Table I and their goitrogenic effect shall be reported elsewhere.

p-Aminobenzophenone was prepared according to Kursanov.[4] This was condensed with the corresponding isothiocyanates prepared according to the author,[5] by the method described previously in this journal.[6] Compounds are listed in Table I. All melting points are uncorrected.

Table I

Thioureido-benzophenones



No.	R=	M.P. °C.	Analysis of sulphur %	
			Theoret.	Found
1	*o*-ClC_6H_4-	58–59	8·7	8·6
2	*m*-ClC_6H_4-	84	8·7	8·5
3	*m*-$CH_3C_6H_4$-	55–56	9·2	9·1
4	*p*-$CH_3C_6H_4$-	70	9·2	9·3
5	*p*-*n*-C_4H_9O-C_6H_4-	76	7·9	7·8
6	*p*-*n*-C_7H_7O-C_6H_4-	95	8·2	8·2
7	*p*-$OCH_3C_6H_4$-	90–91	8·8	8·6
8	*o*-$OCH_3C_6H_4$-	135	8·8	8·8
9	C_6H_5CO-	148	8·9	8·6
10	$(C_6H_5)_2C$-	77–79	6·4	6·4
11	$C_6H_5CH_2$-	53–54	9·2	9·1
12	*p*-$ClC_6H_4CH_2$-	59	8·4	8·3
13	*p*-*n* C_4H_9O-$C_6H_4CH_2$-	87	7·7	7·7
14	*o*-$BrC_6H_4CH_2$-	81	7·5	7·4

Authors thank Dr. N. M. Shah for interest in the work.

Department of Chemistry, A. A. Munshi.
St. Xavier's College, J. P. Trivedi.
Ahmedabad-9, *February* 16, 1961.

1. Burger, *Medicinal Chemistry*, Interscience, 1953, **1**, 143.
2. Storer and Coon, *Proc. Soc. Exp. Biol. Med.*, 1950, **74**, 202.
3. Astwood, *J. Am. Med. Assoc.*, 1943, **122**, 78.
4. Kursanov, D. N., *J. Gen. Chem. U.S.S.R.*, 1943, **13**, 286.
5. Trivedi *et al.*, *J. Ind. Chem. Soc.*, 1956, **33**, 423.
6. Satpanthi and Trivedi, *Curr. Sci.*, 1960, **29**, 346.

MOLYBDATE-TUNGSTATE ANTAGONISM IN *NEUROSPORA CRASSA*

Conclusive evidence for the specific involvement of molybdenum in nitrate assimilation in *Neurospora crassa* has been obtained by the isolation and characterisation of nitrate reductase, a molybdenum containing enzyme.[1]

However, it has been observed that molybdenum may be required by fungi for biochemical functions other than for reduction of nitrate[2,3] That tungstate acts as a specific antagonist of molybdate utilisation was shown in rat,[4] chick,[5] *Aspergillus niger*[6] and *Azotobacter vinelandii*.[7] The possible role of tungstate as an inhibitor of molybdate utilisation in a wild strain of *Neurospora crassa* (Em 5297 *a*) has been investigated and is presented in this note.

The composition of the basal medium used was the same as that of Horowitz and Beadle, as modified by Nicholas and Commissiong[8] and had the following composition in gm. per litre: D-glucose–20 :, KH_2PO_4–3 :, NH_4NO_3–2 :, ammonium tartrate–1 : $MgSO_4 7H_2O$–0·5 :, NaCl and $CaCl_2$–0·1 (each) and the following trace elements in microgram per litre: Zn–200 :, Mn–200 :, Cu–80 :, and Fe–20. In addition, biotin was added at a level of 5 microgram per litre of the medium. In the case of minimal nitrate medium, sodium tartrate (5 gm./litre) was substituted for ammonium tartrate[9] and sodium nitrate (3 gm./litre) for ammonium nitrate and the pH was adjusted to 5·5 and in the case of minimal ammonium medium molybdate was omitted and ammonium tartrate was substituted for ammonium nitrate on an equivalent nitrogen basis. For minimal organic nitrogen medium, DL-alanine (9·3 gm./litre) and sodium tartrate (5 gm./litre) were substituted for ammonium nitrate and ammonium tartrate and molybdate was omitted. 25 ml. of the medium with necessary substrates were dispensed in 250 ml. conical flasks and then sterilised at 15 pounds per square inch pressure for 10 minutes. The inoculum was prepared by suspending in water, washed spores from a 5 to 6 days old slant. One or two drops of the spore suspension was added per flask and the incubation was carried out at room temperature (28 to 30° C.) for 72 hours. The mycelia were then collected, washed, partially dried by filter-paper and then dried to constant weight at 60° C. The fully dried mycelia were then weighed in a Roller-Smith torsion balance.

The macro-nutrients may contain molybdenum, as a contaminant sufficient to support growth of the organism, even without addition of molybdate to the medium. Hence contaminant molybdenum was removed from the inorganic macro-nutrient solution and dextrose by the method of Nicholas.[10] Only pyrex brand glassware, washed with chromic acid, rinsed with hot distilled water several times and finally with glass-distilled water, was used. Glass double distilled water was used throughout.

The results of the investigation of tungstate as an antagonist of molybdate in *Neurospora crassa* grown on different nitrogen sources are presented in Table I. It can be seen from

TABLE I

Effect of tungstate on the growth of Neurospora crassa *on different sources of nitrogen*

Medium*	Molybdenum supplemented to the basal medium (10^{-2} mμM/flask)		72 hours growth of mycelium (Dry weght in mg.)
Nitrate (No tungstate)	..	..	125·0
Nitrate	..	..	50·0
do.	..	7·8	115·0
Nitrate and ammonia (no tungstate)		..	100·0
Nitrate and ammonia	..	..	55·0
do.	..	7·8	102·0
Ammonia (no tungstate)†	..	..	100·0
Ammonia	..	..	100·0
DL-Alanine (no tungstate)†	..	..	123·0
DL-Alanine	..	..	120·0

* Where specifically not stated otherwise, tungstate was also added to provide 81·6 mM. W./flask.

† $5{\cdot}21 \times 10^{-3}$ mμM. molybdenum in the basal medium was omitted in these cases.

Table I that tungstate inhibits the growth of *Neurospora crassa*, in media containing nitrate or nitrate and ammonia, as the sole source of nitrogen. Molybdate reverses the growth inhibition produced by tungstate. This suggests that as in other organisms[2,3] tungstate produces an apparent molybdate deficiency in *Neurospora crassa* also and inhibits certain biochemical processes in which molybdate participates. Tungstate has no effect on the growth of *Neurospora crassa* grown on media having ammonium tartrate or organic nitrogen as sole nitrogen source and under these culture conditions, nitrate reductase has no function and has actually been shown to be absent.[5]

Further work on tungstate-molybdate interrelationship using radioactive isotopes is in progress and will be published in detail elsewhere.

A. RAMAIAH.
E. R. B. SHANMUGASUNDARAM.
University Biochemical Laboratory, Madras-25,
February 22, 1961.

1. Nicholas, D. J. D., Nason, A. and McElroy, W. D., *J. Biol. Chem.*, 1954, **207**, 341 and 353.
2. Mulder, E. G., *Plant and Soil*, 1948, **1**, 94.
3. Agarwala, S. C., *Nature*, 1952, **169**, 1099.
4. De Renzo, E. C., *Ann. New York Acad. Sci.*, 1954, **57**, 905.
5. Higgins, E. R., Richart, D. A. and Westerfeld W. W., *J. Nutrition*, 1956, **59**, 539.

6. Higgins, E. R., Richart, D. A. and Wasterfeld, W. W., *Proc. Soc. Exp. Biol. and Med.*, 1957, **92, 509.**
7. Keeler, R. F. and Varner, J. E., *Arch. Biochem. and Biophys.*, 1957, **70, 585.**
8. Nason, A. and Evans, H. J., *J. Biol. Chem.*, 1953, **202, 655.**
9. Nicholas, D. J. D. and Commissiong, K., *J Gen. Microbiol.*, 1957, **67, 699.**
10. —, *Analyst*, 1952, **77, 929.**

STROMATOLITES IN LOWER CUDDAPAH LIMESTONES (PRECAMBRIAN) IN CUDDAPAH BASIN

KING[1] reported the rocks of Cuddapah System (Precambrian) in Andhra Pradesh to be devoid of any fossils. Srinivasa Rao[2] recorded the occurrence of algæ in limestones of Cuddapah age near Rayalacheruvu in Anantapur District. During the course of field-work among the Lower Cuddapahs in the western part of Cuddapah Basin, the author has observed some features in limestones of both the Vempalle and Tadpatri stages of Lower Cuddapahs. Of these, while some are oolites and concretions, many are stromatolites, laminated structures attributed or possibly attributable to the work of blue-green (or green) algæ. This note records one of the occurrences observed.

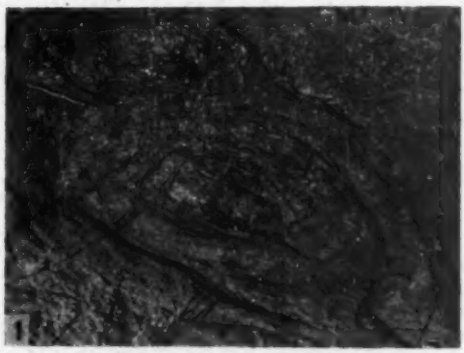
A bed of gray limestone is exposed in a stream flowing north, near the milestone 2/3 between the villages of Pulivendla and Velidendla in Cuddapah District. About 50 feet north of the causeway across the stream is an exposure which abounds in forms of the type shown in Fig. 1. The bed strikes N 45° W–S 45° E and dips 10° due north-east. The detached outcrops of the limestone with the algal colony occupy an area of 40 feet by 30 feet. Figure 1 shows the top view of the stromatolites and Fig. 2 the vertical section across one such form. Comparison of these figures with the various types illustrated and described by Rezak[3] shows that these may be tentatively placed in the form genus *Collenia*. Harlan Johnson[4] is also of the same view.

From a study of the ancient and modern stromatolites, Logan, Rezak and Ginsburg[5] have come to certain conclusions regarding the light these throw on the environments of deposition. A detailed paper on the various other forms of stromatolites met with in this part of the Basin together with their significance will be published elsewhere.

I am grateful to Professor C. Mahadevan for his kind interest in this study. My thanks are due to Professor J. Harlan Johnson, Professor Emeritus, Colorado School of Mines, Golden, Colorado, and Richard Rezak, Shell Development Company, Houston, Texas, for their critical comments and confirmation of the identification.

Geology Department, Andhra University, Waltair, *May* 9, 1961.

R. VAIDYANADHAN.



FIGS. 1-2

1. King, W., *Mem. Geol. Sur. Ind.*, 1872, **8**, 37.,
2. Srinivasa Rao, M. R., *Curr. Sci.*, 1943, **12** (7), 207.
3. Rezak, R., *U.S.G.S. Prof. Paper*, 1957, **294 D**, 127.
4. Harlan Johnson, J., Personal Communication.
5. Logan, B. W., Rezak, R. and Ginsburg, R. N., *Abs. G.S.A.*, 1961, **71** (12), part 2, 1918.

SEPARATION OF RARE EARTHS

SEPARATION of rare earths into their individual components has become one of the most important problems for the present-day chemists. The existing method is separation by ion exchange. One of the authors had previously tried to decompose monazite by heating it with a mixture of calcium oxide and calcium chloride

and leaching the sintered product with dilute acid by which he separated the soluble phosphate from the monazite. The same technique has been tried for the separation of the individual components of rare earths.

Rare earth chloride supplied by the Indian Rare Earth Ltd., Alwaye, was mixed with calcium oxide and calcium chloride and heated in a silica tube to a temperature of 1,000° C. At about 640° C. the mixture was seen to be fusing. On cooling the mixture, it was found to have different patches of varying colours. These different patches were separated by scraping and hand-picking and were spectrographically analysed. Each fraction was found to be the concentrate of individual rare earths mixed with calcium and silica.

This leads to the conclusion that the different coloured patches are due to the formation of complex silicates of rare earths and calcium or calcium compounds of rare earths, *e.g.*, calcium lanthanates, etc. By trying different solvents and also taking advantage of differences in solubility of the different compounds, it is hoped to separate the individual rare earths from these complexes.

Further experiments are in progress to separate the rare earths on the lines mentioned above.

National Met. Lab., Jamshedpur, *May* 5, 1961.

K. N. KARTHA.*
H. V. BHASKAR RAO.**

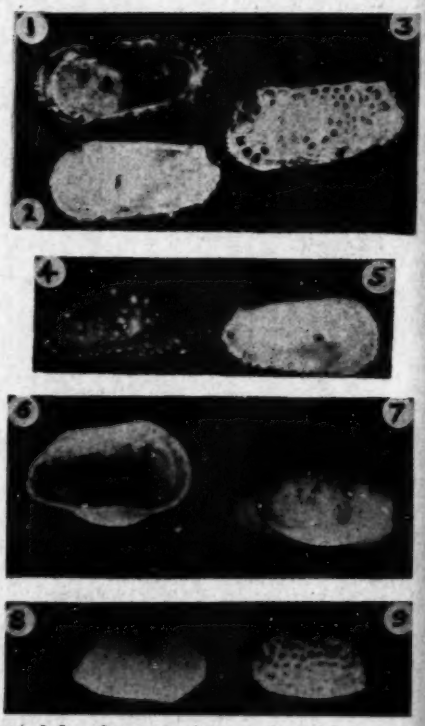
* Junior Research Fellow.
** Assistant Director.

OCCURRENCE OF OSTRACODA IN ROCKS OF PALEOCENE AGE NEAR PONDICHERRY, SOUTH INDIA

THE occurrence of Ostracoda in the Cretaceous-Tertiary area of Pondicherry is noted and here reported for the first time.

In the summer of 1960, I made a systematic collection of rock samples from several Cretaceous and Tertiary outcrops as also from many well sections in the Pondicherry area with a view to making a detailed micropalæontological and sedimentary petrological study, and thereby attempting a classification of these rocks.

In the course of my examination of the washed residues of a marly limestone for smaller foraminifera I noticed some Ostracodes in the sample, mostly in an excellent state of preservation, of which the more commonly occurring ones are shown in the accompanying photographs. Figures 1 and 2 show the internal features of the left and right valves respectively of an Ostracod genus belonging to the Trachyleberidæ. Fig. 3—exterior of the same genus showing a coarsely and deeply reticulate surface. Figs. 4 and 5—another genus belonging to the same family showing exterior and interior respectively of the left valve ; this genus has a smooth surface covered with spines. Figs. 6 and 7 are left and right valves of a genus belonging to Cytheridæ showing interior and exterior respectively. Fig. 8—Right valve of *Bairdia* showing exterior. Fig. 9—Right valve of *Hemicythere* ? showing exterior.



FIGS. 1–9. Ostracoda from rocks of Paleocene age near Pondicherry, South India. Figs. 1–5, × 25. Figs. 6–9, × 40.

On the strength of the occurrence of *Nummulites* together with *Discocyclina* in "one of the limestones collected from near Valadavur", Rama Rao (1939, 1956) suggested the existence of an Eocene bed in the Pondicherry Cretaceous area. In the sample now at my disposal containing the Ostracodes I have not noticed any *Nummulites*. However, it is interesting to note that the Ostracodes are found associated with *Discocyclina* and a keeled *Globorotalia* which

occur in abundance in the sample, besides several other foraminiferal genera. This faunal assemblage clearly indicates a Paleocene age.*

A detailed study of the Ostracoda and foraminifera of this horizon is under progress.

Dept. of Geology, N. RAJAGOPALAN.
Annamalai University,
Annamalainagar, *April* 13, 1961.

1. Rama Rao, L., *Curr. Sci.*, 1939, 8 (4).
2. —, *Proc. Ind. Acad. Sci.*, 1956, 44 (4).

* Dr. M. F. Glaessner of the University of Adelaide, who kindly examined the microfauna of this sample in a personal communication writes, "I have no doubt that this assemblage is in fact of Paleocene age. As you say the presence of a keeled *Globorotalia* together with a *Discocyclina* in the assemblage indicates a Late Paleocene age".

SOME OBSERVATIONS ON PIEDMONTITE FROM GOLDONGRI MANGANESE MINE

EXAMINATION of some piedmontite-bearing rocks from Goldongri Manganese Mine in the Panchmahals district, Gujarat State, led the author to investigate the optical properties of the mineral to find out whether it is manganepidote or piedmontite. The mineral was originally described by Fermor[1] who provisionally identified all the manganese-bearing epidotes occurring in the Indian manganese-ore deposits as piedmontite. However he was aware that the only way to distinguish the manganese epidotes, namely manganepidote and piedmontite, is by the determination of the optic sign and the Mn_2O_3 content of these minerals. Since Fermor, no further study of the Goldongri piedmontite seems to have been undertaken.

The mineral occurs as granular to small prisms in the quartzite and the associated gonditic rocks. It varies from 1 to 6 mm. in length and is purplish red to deep red in colour. Under the microscope it shows strong pleochroism with X = yellow to yellow orange with sometimes a brownish tinge, Y = deep violet, Z = amethyst to carmine; refractive indices: $\alpha = 1{\cdot}740$, $\gamma = 1{\cdot}792$, $(\gamma - \alpha) = 0{\cdot}052$; XZ plane II (010), $y = b$; $(+)\ 2V = 78°$; $X \wedge C = 5$–$6°$.

The optical characters of the mineral, together with the presence of manganese (qualitative test), evidently prove it to be piedmontite and not manganepidote, thus confirming Fermor's expectations.

On comparing its optical characters with those of other piedmontites it is seen that it bears a close resemblance with the piedmontite from Shadow Lake, Madera County, California,[2] in its pleochroism, refractive indices, optic axial angle, etc. Reviewing the literature it is found that the optical characters as recorded are inadequate, and the pleochroism which is most diagnostic has been given for all occurrences. It is said that the optic axial angle and the intensity of pleochroism increase with the increase of manganic oxide, and therefore it is most likely that the large optic axial angle of the piedmontite under investigation may be due to a large content of manganic oxide.

Other minerals associated with it are spessartite and rhodonite. From the mineral associations it is clear that the mineral is intimately associated with the gondite in the present case, while in other areas in India it does not actually occur in the rocks of this series but in the crystalline limestone of the same neighbourhood. A similar occurrence with gondite is reported from the Kajlidongri mine, Jhabua district, M.P., where it is intimately associated with the gondite.

Regarding its origin, the author concurs with Fermor's opinion that it is a product of the metamorphism of the sediments that contained a fair amount of manganese besides lime, iron and alumina.

Therefore, it may be concluded that the manganese epidote under investigation is a true piedmontite and not manganepidote, and is of metamorphic origin.

I am grateful to the Ministry of Scientific Research, Government of India, for the award of a scholarship which has enabled me to carry out this work in the laboratory of the Department of Applied Geology, University of Saugar.

Dept. of Applied Geology, V. K. NAYAK.
University of Saugar,
Saugar (M.P.), *February* 6, 1961.

1. Fermor, L. L., *Mem. Geol. Surv. Ind.*, 1909, 37, Part 1, 187.
2. Short, A. M., *Am. Min.*, 1933, 18, 497.

INSECTICIDAL PROPERTIES OF *ZANTHOXYLUM ALATUM* LINN.

NOT much information is available on the insecticidal properties of the species belonging to the genus Zanthoxylum (Rutaceæ).[1,2] This note presents preliminary observations on the contact toxicity of *Zanthoxylum alatum* Linn., on *Locusta migratoria* L. nymphs. *Z. alatum* Linn. is an armed small tree growing in the foot-hills of the Himalayas. It is also found in the Ganjam hills in South India. Locally it is called "Timru" and "Tejbal", and in the indigenous system of medicine the plant is

noted for its febrifugal, sudorific and diuretic properties and is highly prized as a good dentrifice.

Two sets of experiments were planned to evaluate the toxicity. In the first set 60-mesh powder obtained from air-dried stem bark was used. In the second set, the steam-distilled essential oil from the fruits was used. The fruits yield 1·5% of yellowish essential oil.

In both the sets of experiments one day old nymphs of *Locusta migratoria* L. were used. In each set of experiments fifteen replications were taken each with 10 insects. After the treatment the nymphs were transferred to clean jars and food was provided. The jars were kept at room temperature 26°–29° C. and R.H. 60–70%. Untreated controls were also run side by side.

For the powder treatment the nymphs of each replication were rolled in 0·5 gm. of dust in petri dishes by shaking the dish horizontally until the insects were thoroughly covered with the powder. After one minute they were transferred to clean jars. For testing the oil, the method of Krijgsman and Berger (1949)[3] was followed. A 1% stock solution of oil was prepared in ether. 0·5 ml. of this solution was pipetted in the petri dish and by continuous movement the ether was allowed to evaporate till a more or less thin solid film of oil was left on the glass. Similarly the top inner side of the cover of the petri dish was coated by the oil. The insects were introduced and were allowed to move about for one minute and then transferred to clean jars.

When the insects were treated by the powdered bark they immediately started cleaning their appendages, but a brisk movement of antennæ, legs and other body parts started after 15 to 20 minutes. They were knocked down after 1½ to 2 hours. In the insects exposed to the oil, contortions of the body parts started immediately after the exposure but they lost their sense of orientation in about 20 minutes.

Counts for the mortality were made after 24 hours and it was observed that the powdered bark gave 100% mortality, whereas the oil gave a mortality of only 40%.

Regional Research Lab., Jammuen Tawi,
November 28, 1960.

A. C. MATHUR.
J. B. SRIVASTAVA.
I. C. CHOPRA.

1. Atkinson and Brandis, *vide* George Watt, *A Dictionary of the Economic Products of India*, 1898, **6**, 323.
2. Manson, D., *J. Mal. Inst. Ind.*, 1939, **2** (1), 85.
3. Krijgsman, B. J. and Berger, N. E., *Bull. Ent. Res.*, 1949, **40** (3), 355.

ON THE GENUS *CRYPTOCOCCUS* KUTZING EMEND. VUILLEMIN IN INDIA—A PRELIMINARY REPORT

THE genus *Cryptococcus* has a widespread geographic distribution. Most of its species have repeatedly been cultured from soil, air and various other sources. A close association of the genus with man, animals (van Uden and Cormo-Sousa[1]) and some insects (Shifrine and Phaff[2]) has been reported. Connell and Skinner[3] have found *Cryptococcus albidus*, *C. diffluens*, *C. laurentii* and *C. luteolus* to be a part of the normal saprophytic flora of human skin. di Menna[4] has cultured these four species from cow's raw milk.

Infections due to *Crptococcus neoformans*, the only pathogenic species of the genus, are met with both in man and animals. In this country (Vellore, South India) Khan *et al.*[5] have isolated *C. diffluens*, *C. laurentii* and *C. luteolus* to be of pulmonary cryptococcosis. Apart from this report very little is known about the occurrence and distribution of the genus *Cryptococcus* in India. During routine mycological studies on sputum and other clinical specimens received in this laboratory the authors collected several isolates of yeasts which were identified according to the methods recommended by Lodder and Kreger Van Rij[6] and Wickerham.[7] After verification of the following generic characters seven of the isolates were classified in the genus *Cryptococcus* :

1. Lack of ascospore formation on Gorodkowa agar and potato and carrot plugs.
2. Absence of pseudomycelium.
3. Presence of capsule around the cells (Fig. 1).

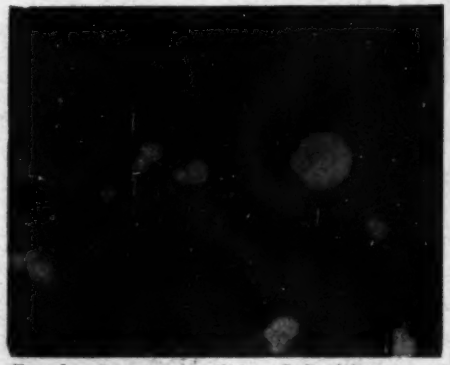


FIG. 1. *Cryptococcus albidus*, India ink preparation showing capsulated yeast cells, × 675.

4. Inability to ferment glucose, galactose, sucrose, maltose and lactose.

5. Synthesis of starch both in the culture medium and the cells.
6. A positive urease test (Seeliger).[8]

In order to derive at the species, assimilation reactions of the test isolates of *Cryptococcus* were noted on potassium nitrate, glucose, galactose, sucrose, maltose and lactose.

The results are summed up in Table I and from there it follows that 5 isolates belong to *C. diffluens* and one isolate each to *C. albidus* and *C. laurentii*. As far as the authors are aware these species have not been previously recorded from India.

TABLE I

Assimilation pattern and origin of seven isolates of Cryptococcus *spp.*

Name of species	Number of isolates	Source of isolation	Assimilation pattern					
			KNO_3	Glucose	Galactose	Sucrose	Maltose	Lactose
C. diffluens (Zach.) Lodder *et* van Rij	4	Sputa	+	+	+	+	+	–
do.	1	Skin scrapings	+	+	+	+	+	–
C. albidus (Saito) Skinner	1	Sputum	+	+	+	+	+	+
C. laurentii (Kufferath) Skinner	1	Throat swab	–	+	+	+	+	+

A detailed description of the above-mentioned three species which showed good agreement with the standard descriptions given for them in the monograph by Lodder and Kreger van Rij,[6] will be published elsewhere.

The writers are thankful to Dr. Libero Ajello, Communicable Disease Centre, Atlanta, U.S.A., for checking one strain of *Cryptococcus diffluens* and to Dr. R. Viswanathan, Director of this Institute, for his interest and encouragement in this study.

R. S. SANDHU.
(MRS.) D. K. SANDHU.
H. S. RANDHAWA.
S. C. CHAKRAVARTY.

Dept. of Medical Mycology,
V.P. Chest Institute,
University of Delhi,
Delhi-6, *March* 13, 1961.

1. van Uden, N. and Carmo Sousa, Lidia Do, *Jour. gen. Microbiol.*, 1957, **16**, 385.
2. Shifrine, M. and Phaff, H. J., *Mycologia.*, 1956, **48**, 41.
3. Connell, G. H. and Skinner, C. E., *Jour. Bact.*, 1953, **66**, 627.
4. di Menna, Margaret E., *Antonie van Leeuwenhoek.*, 1956, **22**, 331.
5. Khan, M. J., Ruth Myers, M. S. and Koshy, Grace, *Dis. Chest.* 1959, **36**, 656.
6. Lodder, J. and Kreger van Rij, N. J. W., North Holland Publishing Co., Amsterdam, 1952, Pp. 6–35.
7. Wickerham, L. J., "Taxonomy of yeasts," *U.S. Dept. Agriculture Tech. Bull. No.* 1029, 1951, 2–19.
8. Seeliger, Heinz, P. R., *Jour. Bact.*, 1956, **72**, 127.

METACERCARIA OF *APHANURUS* SP. (TREMATODA-HEMIURIDAE) FROM A COPEPOD *ACROCALANUS GRACILIS* (GIESBRECHT) OFF WALTAIR COAST

THE occurrence of the metacercariæ of hemiurid trematodes of fishes in planktonic copepods have been reported from time to time by various workers. Steuer[1] discussed the geographical distribution and affinities of the appendiculate trematodes parasitising marine planktonic copepods of the northern seas. The occurrence of metacercariæ of *Derogenes varicus, Hemiurus communis* and *Lecithaster confusus*, in *Acartia* sp. have since been reported by other workers.[2–4] The progenetic metacercaria of *Derogenes varicus* has also been reported from a parasitic copepod, *Lernæocera lusci* on Gadoid fishes by Dollfus.[5] The metacercaria of *Bunocotyle cingulata* has been described from a brackish water copepod by Chabaud and Biguet.[6] Hemiurid larvæ have also been reported from the deep sea copepod *Pleuromamma gracilis* by Steuer[7] and from *Calanus finmarchicus* by Marshall and Orr.[8] Krishnaswamy[9] and Sewell[10] have reported the occurrence of hemiurid larvæ in *Paracalanus aculeatus, Clausocalanus furcatus, Corycæus gibbulus* and *Oncæa venusta* from the Indian seas.

While examining the plankton collected in the inshore waters off Waltair, some of the copepodites of *Acrocalanus gracilis* were observed to be brick-red in colour owing to the presence of the metacercariæ of trematodes in their body cavity. Only a single parasite was harboured by each copepodite. We observed the parasite only on one occasion in an adult host. Incidentally this is the first report of the occurrence of hemiurid metacercariæ from the present host and also the first description of the metacercaria of *Aphanurus*.

The metacercariæ show characteristic annulations and measure 0·49 mm. in length and 0·16 mm. in the greatest width. The oral sucker (0·036 mm. × 0·029 mm.) situated at the anterior end leads into a muscular pharynx and

two cæca which reach to the posterior end. The circular acetabulum (0·10 mm.) is more than twice as large as the oral sucker, situated at 0·11 mm. below the anterior end. The testes (0·025 mm. × 0·057 mm.) are oval bodies arranged linearly in the posterior half of the body, with the ovary (0·025 mm. × 0·043 mm.) posterior to them. The seminal vesicle is immediately pretesticular with the pars prostatica well developed. The vitellarium (0·046 mm. × 0·071 mm.) is single, compact and reniform situated immediately behind the ovary. The excretory vesicle is Y-shaped, with a long median stem and long lateral canals containing granules, which unite dorsal to the pharynx.

The characters of the larva, such as the presence of cuticular plications, the size of the acetabulum being more than twice that of the oral sucker, the single compact vitellarium and the Y-shaped excretory vesicle with the anterior transverse vessel dorsal to the pharynx show that the metacercariæ belong to the genus *Aphanurus* of the family Hemiuridæ.

Dept. of Zoology, Andhra University, Waltair, *March* 2, 1961.

P. N. GANAPATI.
K. SHANTHAKUMARI.

1. Steuer, A., *J. Parasit.*, 1928, **15** (2), 115.
2. *Hall, M. C., *Smithson. Misc. Coll.* 1929, **81** (15), 1.
3. Lebour, M. V., *J. Mar. Biol. Ass.*, U.K., 1935, **20**, 371.
4. Hunninen, A. V. and Cable, R. M., *J. Parasit.*, 1943, **29** (1), 71.
5. Dollfus, R. Ph., *Vie et Milieu*, 1954, **5**, 565.
6. Chabaud, A. G. and Biguet, J., *Ann. Parasit. hum. Comp.*, 1955, **29** (5–6), 527.
7. Steuer, A., *Wiss. Ergebnisse der Deutschen Tiefsee Expedition*, 1932, **24**
8. Marshall, S. M. and Orr, A. P., *The Biology of a Marine Copepod* Calanus finmarchicus *(Gunnerus)*, Edinburgh, Oliver and Boyd, 1955, pp 188.
9. Krishnaswamy, S., *J. Madras Univ.*, 1950, **20**, 75.
10. Sewell, R. B. S., *The John Murray Exped.* 1933–34, *Scientific Reports*, 1951, **9**, 346.
11. Yamaguti, S., *Systema helminthum* Interscience Pub. Inc., New York, 1958, **1**, Parts 1–2, 1575.

* Original not referred.

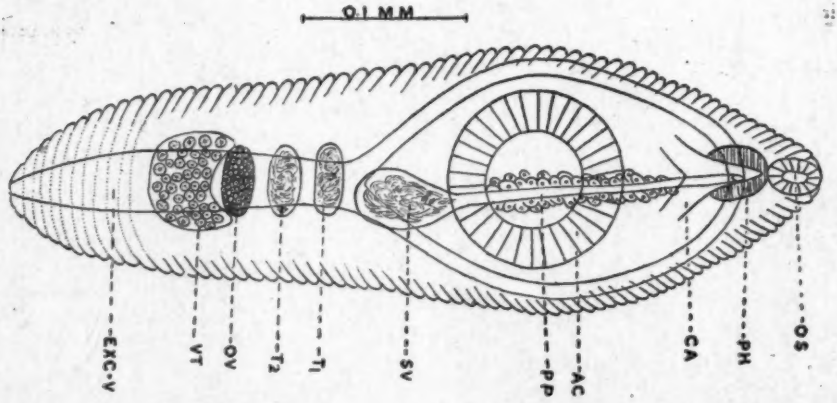


FIG. 1. Metacercaria of *Aphanurus* sp.: *AC*, Acetabulum; *CA*, Cæcum; *EXC. V*, Excretory vesicle; *OS*, Oral sucker; *OV*, Ovary; *PH*, Pharynx; *PP*, Pars prostatica; *SV*, Seminal vesicle; T_1, T_2, Testes; *VT*, Vitellarium.

It would appear that the copepodites and adults of *Acrocalanus gracilis* (Giesbrecht) form the natural intermediate hosts for a species of adult *Aphanurus* which has been found to occur frequently in *Sardinella gibbosa* (Bleeker) and *Sardinella fimbriata* (Cuvier and Valenciennes) which are common edible fishes off this coast.

One of us (K. S.) is indebted to the C.S.I.R. for the award of a Research Fellowship during the tenure of which the work was undertaken.

ON THE GROWTH OF ANTENNAE OF *GERRIS FLUVIORUM* F. (HEM., GERRIDIDAE)

IN the course of studies on the development of *Gerris fluviorum* F. one of us (G. T. T.) noticed that the growth of the individual antennal segments occurs at a rate different from that of the antenna as a whole as well as that relative to one another.[5,6] A quantitative study

of relative growth of the four antennal segments was therefore undertaken with a view to applying our data to the notation suggested by Huxley and Teissier.[1] The number of instars required for neanides of *Gerris fluviorum* F. to reach the adult stage is five.[6] Significant change in the lengths of antennal segments takes place during development and Table I gives the details of the increments of growth at each moult. The first two antennal segments are relatively short in the first neanidal instar and they form a progressively larger proportion of the total antennal length in the subsequent instars. Conversely, the remaining two segments are relatively long in the first instar and form a progressively smaller proportion of the total antennal length. Thus a change in proportion in the lengths of the antennal segments during the neanidal life of *G. fluviorum* F. is clearly demonstrated. We have followed Miller in using the term 'neanide' in preference to 'larva' or 'nymph'.[3] For the sake of brevity, only the most essential calculations are included.

TABLE I

Lengths (mean of 15 individuals) of antennal segments in different instars of G. fluviorum *F. (in mm. ± ·03)*

Instar	Antennal Segments				Total
	I	II	III	IV	
	y	*y*	*y*	*y*	*x*
1	·39	·31	·48	·90	2·08
2	·74	·43	·68	1·11	2·97
3	1·17	·71	·81	1·30	3·99
4	1·50	1·16	1·15	1·49	5·30
5	1·91	1·45	1·38	1·78	6·52
Adult	2·50	1·9	1·6	2·1	8·10

The recognised notation for the law of allometry has been expressed as $y = bx^a$ where y is the part; x is the standard or whole and a and b are constants. When $a > 1$ we have an instance of positive allometry; when $a < 1$ it is a case of negative allometry and when $a = 1$ the growth is isometric. Introducing logarithms, it can be written as $\log y = \log b + a \log x$ which assumes the form $Y = a X + B$ where $X = \log x$; $Y = \log y$ and $B = \log b$. The base of the logarithms can be 10 or e. Here we have taken the base as 10. The normal equations to determine the optimum values of a and B are:

$$a \Sigma X^2 + B \Sigma X = \Sigma XY \quad (1)$$
$$a \Sigma X + 6B = \Sigma Y \quad (2)$$

From the above data and adapting the standard method of the 'calculus of observations' the constants a and b can be evaluated. Thus for the first segment we get $a = 1{\cdot}33$ and $b = 0{\cdot}16$. The equation describing the first segment is $y = 0{\cdot}16\, x^{1{\cdot}33}$. The equation for the best-fitting line is $Y = 1{\cdot}33\,X - 0{\cdot}7846$. Following the same procedure for the second segment we obtain $a = 1{\cdot}4$ and $b = 0{\cdot}10$ so that the equation is $y = 0{\cdot}10\, x^{1{\cdot}4}$ and the equation for the best-fitting line is $Y = 1{\cdot}4\,X - {\cdot}9986$. Similarly the normal equations to the third segment give $a = 0{\cdot}46$ and $b = {\cdot}0010$ so that the equation is $y = 0{\cdot}0010\, x^{0{\cdot}46}$ and the best-fitting line is $Y = 0{\cdot}46\,X - 2{\cdot}9864$. And the normal equations for the fourth segment give $a = {\cdot}60$ and $b = 1{\cdot}21$ so that the equation is $y = 1{\cdot}21\, x^{0{\cdot}60}$ and the best fitting line is $Y = 0{\cdot}60\,X - 0{\cdot}08$.

The employment of logarithms is of advantage in plotting the data in a graph since it makes the graph a straight line which otherwise would be a non-linear curve.[2] Fig. 1 gives the graph of the best-fitting straight lines which describe the growth of each segment.

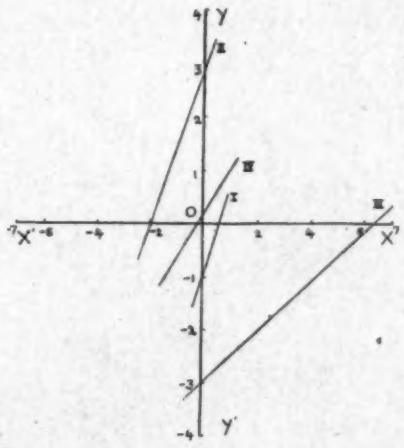


FIG. 1. Graphs of the best-fitting lines describing the growth of the four antennal segments of *Gerris fluviorum* F. Scale on X-axis 1″=2. Scale on Y-axis 1″=1.

It can be readily appreciated that the first two antennal segments show a positive allometry whereas the remaining two segments indicate a negatively allometric growth. Studies on the growth of other cuticular structures are currently under progress and a fuller discussion of the data will be published elsewhere.

It is a pleasure to acknowledge the facilities provided by the University of Poona. We are thankful to the Head of the Department of Zoology for encouragement.

University of Poona, Ganeshkhind, Poona-7, *March* 10, 1961.

G. T. TONAPI.
B. RAJA RAO.

1. Huxley, J. S. and Teissier, G., *Nature*, 1936, **137**, 780.
2. De Beer, G. R., In the *New Systematics*, 1940, London.
3. Miller, N. C. E., *The Biology of Heteroptera*, 1956, London.
4. Tonapi, G. T., *Ent. Mon. Mag.*, 1959, **35**, 29–31.
5. —, *Entomologist*, 1961 (In press).
6. —, Unpublished data.

A SIMPLE METHOD OF REDUCING VARIATIONS OF CURRENT DURING ELECTROPHORESIS

FOR electrophoretic separation of the proteins of the sheep serum, the apparatus of A. H. Thomas Company of U.S.A. (No. 4937-W. 5) and a "Sola" constant voltage transformer were used here. The veronal buffer used had a pH of 8·6 and ionic strength of 0·1. The applied voltage was 75 V. and duration of run 18 hours at the room temperature of about 25° C. The total current through four Whatman 3 M.M. paper strips, each $1\frac{1}{2}'' \times 12''$, was 4·5 m.a at the start of the run, but towards the end increased to 6 to 7·5 m.a. Evaporation was excessive and records showed poor reproducibility. Keeping the cabinet in a low temperature incubator improved matters, but this was inconvenient. A constant current assembly was not available.

After a few trials with different values, a 0·1 Meg. potentiometer was used as a variable resistance in series with the paper strips. At a voltage of 275 V. the external resistance was adjusted to allow 5 m.a. of current to flow through the circuit. The change in the resistance of the paper strips had only a negligible effect now because of the high overall resistance. At the end of the run of 18 hours, the current increased by only 0·25 m.a. Reproducibility was excellent.

Dept. of Physiology, Madras Veterinary College, Madras-7, *March* 8, 1961.

K. N. GOVINDAN NAYAR.

A HETEROPOLYSACCHARIDE FROM *PASTEURELLA MULTOCIDA*, ROBERTS' TYPE I

LITTLE is known of the carbohydrates of *Pasteurella multocida*, Roberts' type I, the causal organism of hæmorrhagic septicæmia in cattle and buffaloes. We have examined the strain (P_{52}) of *P. multocida*, used in this laboratory for the preparation of an oil-adjuvant vaccine[1] with the object of obtaining material which might be of value in immunological studies. Various methods of extraction like heating in a water-bath at 56° C. for 1 to 6 hours,[2,3,5,6] and treatment with different solvents like phenol[4,5] and trichlorotrifluoroethane[5] were tried by earlier workers but this paper describes physico-chemical immunobiological characterisation of a polysaccharide that was recovered by fractional precipitation with ethanol at 68% (V/V) concentration from extracts prepared from acetone-dried yeast-extract agar-grown cells of *P. multocida* after hydrolysis with N/4 NaOH for 5 to 6 hours at 56° C.

The materials were white powders, easily soluble in water, forming viscous solution, slightly acidic in reaction and contained 1·8 to 2·0% nitrogen and traces of phosphorus (< 0·1%). They reacted negatively in the biuret, Millon and ninhydrin tests. They gave a positive anthrone reaction for carbohydrates and did not show the presence of any free sugar or nucleic acid.

When the samples of polysaccharides were hydrolysed in 0·5 N H_2SO_4 and the hydrolysates chromatographed in four solvent systems, galactose and ribose were the only sugars detected. Precipitation-inhibition tests substantiated their presence. The identity of galactose was confirmed by the preparation of *d*-methylphenylhydrazone. No evidence for the presence of amino-sugars, uronic acids or aldoheptoses could be obtained by the application of colorimetric tests.[7–9] The washed suspensions of cells of *P. multocida* were found to contain approximately 2·5 to 3% of their dry weight as carbohydrate when analysed by the anthrone procedure of Trevelyan and Harrison,[10] using galactose as the standard. These values closely agreed with those reported by Carter and Annau,[2] Briefman and Yaw[3] and Dhanda[5] for extracts obtained by different techniques.

The polysaccharide was not toxic nor pyrogenic when injected into mice and rabbits. It could not act either as a preparing or as shocking reagent in the elicitation of generalised Schwartzman reaction in rabbits. It gave positive precipitation reactions (1 : 150,000 to 1 : 500,000) with *P. multocida* type I antiserum, sensitised erythrocytes (the optimal concentration being 500 micrograms/ml.) to agglutination by the antisera and to lysis in the additional presence of complement. It itself inhibited the agglutination and lysis of sensitised erythrocytes by antisera (12·5 micrograms/ml.). It, thus, possessed the properties of a complex hapten. No antibody formation could be detected following

injections of the polysaccharide into rabbits but high titre antisera could be produced by administration of antigen-coated erythrocytes.

On diffusion against type I antiserum, the polysaccharide gave rise to a single line of precipitation and proved to be heat-stable but sensitive to the action of potassium periodate.

The polysaccharide was not immunogenic in mice, rabbits and cattle and pure polysaccharide antisera failed to exhibit any murine passive protective activity. However, when tested on the lines of Rowley,[11] it stimulated non-specific immunity to an extent approaching that caused by *Escherichia coli* 2038. It was found to possess antiphagocytic and virulence-enhancing activity at low concentrations.

The polysaccharide preparations absorbed very little of the homologous mouse-protective activity from a rabbit type I whole-cell antiserum. However, intra-abdominal injection of 30 micrograms of these preparations diminished the immune response of mice to subsequent injections of an effective type I vaccine, thus manifesting its immunological activity by the interference effect and suggesting degradation during purification.

Synthetic polyglucoses which contain a variety of linkages with 1-4, 1-6 and 1-4-6 predominant and a number of glycogens which contain 1-4-6 branching points showed no cross-reaction with the pure polysaccharide antiserum.

The polysaccharide failed to inhibit hæmagglutination of fowl erythrocytes by Newcastle disease virus or block the specific blood group antigens tested so far.

The relationship of this polysaccharide extracted by a modification of the alkaline hydrolysis method of Thomas and Mennie[12] to the capsular polysaccharides (fraction IV) obtained by the senior author[5] and other workers[2,3,4,6] is being investigated intensively in the laboratory at Mukteswar.

College of Vet. Sci.,
U.P. Agri. University,
P.O. Pantnagar, Dist.
Nainital, *April* 29, 1961.

M. R. Dhanda.
Prem Prakash.
P. C. Sekariah.*

* Division of Pathology and Bacteriology, Indian Veterinary Research Institute, Mukteswar-Kumaon, U.P.

1. Dhanda, M. R., Das, M. S., Lall, J. M. and Seth, R. N., *Ind. J. Vet. Sci. and Anim. Husb.*, 1956, **26**, 273.
2. Carter, G. R. and Annau, E., *Amer. J. Vet. Res.*, 1953, **14**, 475.
3. Briefman, L. and Yaw, K. E., *J. Bact.*, 1958, **75**, 236.
4. MacLennan, A. P. and Rondle, C. J. M., *Nature*, London, 1957, **180**, 1045.
5. Dhanda, M. R., *Ind. Vet. J.*, 1959, **36**, 6.
6. Prem Prakash and Dhanda, M. R., Unpublished data, 1960.
7. Boas, N. F., *J. Biol. Chem.*, 1953, **204**, 553.
8. Dische, Z., *Ibid.*, 1947, **167**, 189.
9. Davies, D. A. L., *Biochem. J.*, 1957, **67**, 253.
10. Trevelyan, W. E. and Harrison, J. S., *Ibid.*, 1952, **50**, 298.
11. Rowley, D., *Brit. J. Exp. Path.*, 1956, **37**, 223.
12. Thomas, J. C. and Mennie, A. T., *Lancet*, 1950, **2**, 248.

A NOTE ON TERMITES (INSECTA: ISOPTERA) INFESTING SUGARCANE CROP IN RAJASTHAN

A note on an infestation of termites around Udaipur in Rajasthan was recently published by the author,[1] in which were reported 4 different species, *viz.*, *Odontotermes* (*O.*) *obesus* Rambur, and *Odontotermes* (*Odontotermes*) *obesus* f. *gurdaspurensis* Holmgren, *Odontotermes* (*Odontotermes*) *bangalorensis* Holmgren [syn. *Odontotermes* (*Cyclotermes*) *bengalensis* Holmgren], *Microtermes anandi* Holmgren (syn. *Microtermes obesi* Holmgren) and *Trinervitermes biformis* (Wasmann) as infesting cultivated fields, orchards and forest trees. The present observations refer to widespread damage caused to sugarcane (*Saccharum officinarum* Linnaeus) cultivation by various species of termites in the districts of Udaipur, Chittor and Sawai Madhopur in the State of Rajasthan.

Fig. 1. Showing termite (white ants) damage in sugarcane. (*a*) Plant showing excavated tunnel at the base above-ground. (*b*) Thin outer rind of the damaged setts has been stretched out to expose the soil within. (*c*) Clod of soil within the damaged sett. (*c'*) Underground setts cut open to show the excavated tunnels compactly filled with soil.

Two species, namely, *Odontotermes* (*Odontotermes*) *obesus* Rambur and *Microtermes anandi* Holmgren (Family: Termitidæ; Subfamily:

Macrotermitinæ) have been commonly observed by the writer as major pests of sugarcane in all these Districts. Both species have been observed attacking mostly the underground setts, independently and sometimes simultaneously. Generally the damage starts through the cut ends and gradually the entire pith is eaten up. The tunnels excavated thus are compactly filled up with moist soil leaving only the live galleries within, but the outer rind is always spared and left intact as a thin covering (Fig. 1). The growing shoots at their base show a similar damage. Consequently the plants exhibit a stunted growth and ultimately dry up. Generally the attack is more serious within the first 4 or 5 months of sowing. At Bhupalsagar (District: Chittor) and in the adjoining area the pest has been incessantly attacking the sugarcane crops, and the damage during March, 1960 was so severe in certain plots that the entire crop in these had to be destroyed to check the infestation from spreading.

Another species, *Odontotermes* (*Odontotermes*) *brunneus* (Hagen), so far not recorded from Rajasthan, was also collected from mounds adjacent to sugarcane fields at Bhupalsagar, but no damage to the crop was observed.

Control trials conducted so far have failed to destroy the pest and have given no conclusive results, probably, because of their peculiar capacity for avoiding the treated plots.

My sincere thanks are due to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for identification of the specimens and Shri Y. Ramchandra Rao for going through the note and making a few kind suggestions. I am also very grateful to Dr. A. Rathore, Principal, Rajasthan College of Agriculture, Udaipur, for laboratory facilities.

K. S. KUSHWAHA.
Dept. of Zoology & Entomology,
Rajasthan College of Agriculture,
Udaipur (Rajasthan),
January 25, 1961.

1. Kushwaha, K. S., *Sci. and Cult.*, 1960, **26**, 39.

AN UNUSUAL MODE OF EGG-LAYING IN *TROGODERMA GRANARIUM* EVERTS (DERMESTIDAE: COLEOPTERA), A PEST OF STORED CEREALS

Trogoderma granarium Everts is a serious pest of stored cereals in India. Recently, it has gained entry into California and has established itself there.[1] Although the pest had been mentioned in Indian entomological literature as early as in 1894[2] and its biology extensively studied,[3-5] the workers have apparently failed to make a very interesting and important observation about the egg deposition.

During the present investigation, when the insects were being reared at $33 \pm 1°$ C., eggs were found in clusters at the caudal end in between the last larval exuvium and the pupal skin (Figs. A and B) before the emergence of adults. Normally the eggs are laid among the grain.[4] The number of eggs in each instance, in the present case, varied from 15 to 45. Their viability was studied and about 80% of the eggs were found viable. The sex ratio of the adults

FIGS. A–B. A. Matured pupa enclosed in last larval exuvium, with the eggs (*e*). B. The caudal end highly magnified, showing the eggs (*e*) in between the last larval exuvium and pupal skin.

from such eggs was also studied. No significant difference was, however, observed when compared with normal sex ratio. As to the source of these eggs, it was first thought to be due to parthenogenesis, but when the clean larvæ free from any extraneous material were placed singly in glass specimen tubes (2·5″ × 0·5″) and allowed to come up to the adult stage, no egg was noticed. When matured pupæ formed from such larvæ were placed together with the adults from the culture, the eggs were found present in some cases in between the last larval exuvium and the pupal skin. This was more prominent under conditions of crowding.

It is possible that *T. granarium* in this way probably exhibits parental care of Brutfursorge type, i.e., providing shelter for the development of eggs against natural enemies.

The present observation has an important bearing on the control of this serious pest. Sometimes in storage godowns the presence of mere exuviæ is not at all taken seriously. The concealed eggs in between these last larval exuviæ and the pupal skins may then prove to be a constant source of infestation which more often than not escape the notice of technical staff undertaking control measures.

The authors are thankful to Dr. E. S. Narayanan, Head of the Division, for his keen interest in these investigations.

Division of Entomology, SNEHAMOY CHATTERJI.
Indian Agricultural PRAKASH SARUP.
Research Institute,
New Delhi-12, *January* 3, 1961.

1. Lindgren, D. L., Vincent, L. E. and Krohne, H. E., *Hilgardia*, 1955, **24** (1), 1.
2. Barnes, J. H. and Grove, A. J., *India Dept. Agr. Mem.*, 1916, **4** (6), 165.
3. Hinton, H. E., *A Monograph of the Beetles Associated with Stored Products*, British Museum, London, 1945, **1**, 443.
4. Pruthi, H. S. and Singh, M., *Indian J. Agric. Sci.*, 1950, **18** (4), 1 (Special Number).
5. Lindgren, D. L. and Vincent, L. E., *J. econ. Ent.*, 1959, **52** (2), 312.

TWO NEW RECORDS IN SOIL FUNGI

Two species of fungi, *Thielavia sepedonium* Emmons, and *Trichurus spiralis* Hasselbring, hitherto, unrecorded from soil, have been isolated from soil samples collected from various localities in India listed in Table I.

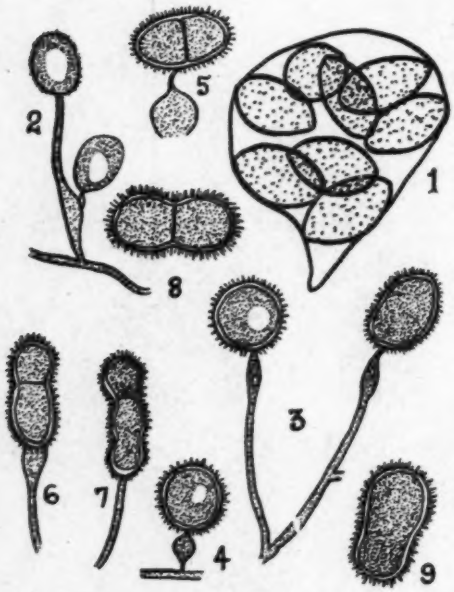
Thielavia sepedonium Emmons (Photo A, Figs. 1-9) conforms in general to its original description,[1] except that the strain encountered here occasionally produces two-celled and at times irregularly-shaped conidia. This form has been isolated from about 80% of the soil samples examined. A living culture has been deposited in the Commonwealth Mycological Institute, Kew, England, under reference No. I.M.I. 82620.

TABLE I

Fungus	Locality				
	Darjeeling pH 6·5	Hardoi pH 7·5–9·0	Kanpur pH 7·0–9·0	Lucknow pH 6·0–9·5	Rae Berali pH 6·8–9·0
Thielavia sepedonium Emmons	–	+	+	+	+
Trichurus spiralis Hasselbring	+	–	+	+	–

PHOTOS A–B. A. Cleistothecia, conidia and ascospores of *Thielavia sepedonium* Emmons, × 172. B. Coremia of *Trichurus spiralis* Hasselbring, × 34.

Trichurus spiralis Hasselbring (Photo B) is characterised by the presence of stalked coremia bearing penicilli on long threads and long, tortuous, sterile, septate hair, which are brown near the base, becoming hyaline at the tips, giving the fructification a characteristic flocculent appearance.[2] This form has been isolated from about 2% of the soil samples examined. A living culture has been deposited in the Commonwealth Mycological Institute, Kew, England, under reference No. I.M.I. 82621.



FIGS. 1–9. *Thlaspia sepedonium* Emmons. Fig. 1. Ascus. Fig. 2. A conidiophore with young conidia. Figs. 3, 4. Conidiophores with mature conidia. Fig. 5. A conidiophore with two-celled conidium. Figs. 6, 7. Conidiophores with two-celled irregularly-shaped conidia. Fig. 8. A two-celled conidium. Fig. 9. An irregularly-shaped conidium. All figures, × 1,160.

We are grateful to the Director, Commonwealth Mycological Institute, Kew, England, for his help in the identification of the forms described. Thanks are also due to the Ministry of Scientific and Cultural Affairs, Government of India, for the grant of a Research Training Scholarship, and to the Council of Scientific and Industrial Research, New Delhi, for the award of a Research Fellowship to the junior authors during the tenure of which this work has been done.

Dept. of Botany, Lucknow University, Lucknow (India), *December* 22, 1960.

J. N. RAI.
K. G. MUKERJI.
J. P. TEWARI.

1. Emmons, C. W., *Bull. Torrey Bot. Club*, **1932**, **59**, 415.
2. Hasselbring, H., *Bot. Gaz.*, 1900, **29**, 312.

PACHYTENE ANALYSIS IN *MELILOTUS SEGETALIS* SCHULZ.

KARYOMORPHOLOGICAL studies in species with small chromosomes are most profitably undertaken by the analysis of the pachytene stage in PMCs. This statement is amply substantiated by the studies on *Zea*, *Lycopersicon*, *Plantago*, *Sorghum*, *Oryza* and several other materials where the karyological study of somatic metaphases in root tips is very difficult. In the genus *Melilotus*, pachytene analysis was initiated by Shastry, Smith and Cooper (1960) by the analysis of the F_1 hybrid, *M. messanensis* × *M. segetalis*. Later, Shastry and Cooper (1961) investigated the karyomorphology of *M. messanensis* at pachytene. In the present note, the pachytene analysis of *M. segetalis*, compared to that of *M. messanensis*, is reported. The techniques employed are similar to those described by Shastry *et al.* (1960).

Pachytene bivalents of *M. segetalis*, like those of *M. messanensis*, are more or less uniformly stained with no distinct macrochromomers, but with some darkly-stained heterochromatic regions (chromosomes 2, 3 and 6). While the full complement of chromosomes was analysed in 5 PMCs only, 4–5 bivalents were analysed in 20 cells. The cell-to-cell variation in lengths of bivalents was 4–6 μ, which is negligible. Individual chromosomes were identified by length, arm ratio and heterochromatic pattern and were numbered in the descending order of their length.

Figures 1 and 2 show PMCs in which the entire complement is analyzable. The lengths and arm ratios of the bivalents of the species, *M. segetalis*, as compared to those of *M. messanensis* (Shastry and Cooper, 1961) are given in Table I.

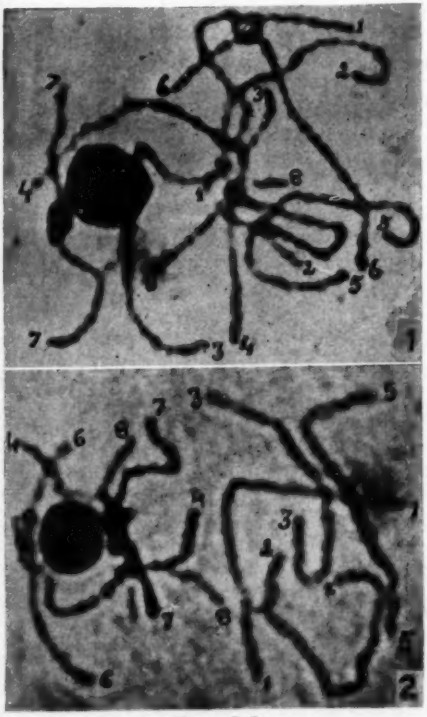
It will be seen from Table I that the individual bivalents of both the species are more or less comparable in their total lengths and arm ratios. The differences were observed in chromosomes 2, 7 and 8 with regard to arm ratios and 1, 2 and 8 in total length. Such minute differences could not have been detected if the karyotype was analyzed at somatic metaphase. The karyotypes of both the species

TABLE I

Data on lengths and arm ratios of bivalents of M. segetalis *in comparison to those of* M. messanensis

(Data on *M. messanensis* taken from Shastry and Cooper—in press)

No. of the chromosome	Length in Microns						Arm Ratio	
	Short arm		Long arm		Total		Short/Long arms	
	M. messanensis	*M. segetalis*	*M. messanensis*	*M. segetalis*	*M. messanensis*	*M. segetalis*	*M. messanensis*	*M. segetalis*
1	28·8	29·8	39·0	44·0	67·8	73·8	0·74	0·68
2	22·8	18·7	26·4	41·2	49·2	59·9	0·86	0·45
3	12·0	15·7	22·8	23·5	34·8	39·1	0·53	0·67
4	15·6	12·8	19·2	19·9	34·8	32·7	0·81	0·65
5	9·6	8·1	25·2	23·8	34·8	31·9	0·38	0·34
6	8·4	10·2	18·6	17·1	27·0	27·3	0·45	0·60
7	3·6	7·8	14·4	14·9	18·0	22·7	0·25	0·52
8	4·2	7·9	7·8	10·7	12·0	18·9	0·54	0·74



FIGS. 1–2

fall under group 2-C of Stebbins' (1958) classification.

The authors are grateful to Dr. B. P. Pal, Director, and Dr. A. B. Joshi, Dean, for providing facilities and to Prof. W. K. Smith, University of Wisconsin, for making available the seeds of *M. segetalis*.

Division of Botany, Indian Agricultural Research Institute, New Delhi-12, *February* 14, 1961.

D. R. RANGA RAO.
S. V. S. SHASTRY.

1. Shastry, S. V. S., Smith, W. K. and Cooper, D. C., *Amer. Jour. Bot.*, 1960, **46**, 613.
2. — and Cooper, D. C., *Jour. Heredity*, 1961 (in press).
3. Stebbins, G. L. Jr., Cold Spring, *Harb. Symp. Quant. Biol.*, 1958, **23**, 365.

FLINT × DENT MAIZE HYBRIDS GIVE INCREASED YIELDS

IN the early stages of research on the development of hybrid maize in India mainly indigenous open-pollinated strains were utilized for the development of parental inbred lines of the hybrids. As a result of these researches a three-way cross (I 5 × L 5)S 23,[1] and a double-cross hybrid, Punjab Hybrid No. I,[2] were evolved and put into limited commercial production in the States of Mysore and Punjab respectively. These hybrids yielded about 15 to 20% more than the best open-pollinated varieties under cultivation. While some gain had been made, the increased yields were not as high as those obtained from hybrids developed in the U.S.A., Mexico and Colombia.[3] Research work in the U.S.A. has shown that hybrids produced from inbred lines of diverse genetic origin give considerably more yield than those produced by crossing related lines.[4–6]

Researches were initiated at the Indian Agricultural Research Institute, New Delhi, in 1954 to study the performance of genetically diverse inbred lines in hybrid combinations, and to evaluate the utility of exotic germ plasm in the Indian hybrid maize programme. Two different

experimental procedures were employed to study this aspect of the problem.

I. Eleven flint inbred lines, developed from Indian open-pollinated varieties and possessing high general combining ability, were taken. One such line, PB 4, originating from a Bihar open-pollinated variety, was used as the tester parent and crossed to four other lines from Bihar germ plasm (group A). The tester line was also crossed to seven other inbred lines originating from Indian germ plasm sources other than Bihar (group B). Lastly the tester line was crossed to four dent lines originating from U.S.A. (group C). The lines from U.S.A. were parents of established maize hybrids in commercial production in that country. These three groups of single crosses, along with the local open-pollinated variety, KT 41, as check, were tested in a replicated yield trial.

The average yield of the single crosses in group A was 2,586 lb. per acre, which was about 24% more than the local check variety, KT 41. The group B yielded on an average 2,984 lb. per acre which was 43% more than the local variety. The difference between the two groups A and B was significant and in favour of group B. Group C, comprising the most diverse germ plasm combinations, yielded 3,306 lb. per acre, which was 58% more than the check KT 41. This group of hybrids significantly outyielded those in groups A and B.

Group C on an average took 54 days to silk as against 56, 55 and 50 days to silk for the groups A, B, and the check variety respectively. Thus group C was superior in yield to the two other groups and the local variety and had about the same maturity as the local check.

II. The second procedure of testing the effect of genetic deversity was as follows :—

An Indian open-pollinated variety PY 2, adapted to Delhi area, was used as the tester. It was crossed to 24 inbred lines developed from the Indian open-pollinated varieties (group X) and 20 dent inbred lines from U.S.A. (group Y). Inbred lines in group Y represented the genetically diverse germ plasm in this experiment. The two sets of top crosses, along with the tester parent PY 2, and the recommended local open-pollinated variety KT 41, were studied in a replicated randomized trial.

The average yield of the top crosses in group X was 3,382 lb. per acre and group Y 4,093 lb. per acre; the tester parent PY 2 yielded 2,422 lb. per acre. Groups X and Y were significantly superior to the tester by 42 and 69% respectively. Moreover, group Y significantly outyielded X by 21%.

These studies clearly indicated that dent inbred lines, representing more diverse genetic source than Indian lines, gave superior performance in combinations with Indian germ plasm than Indian × Indian combinations.

Division of Botany, N. L. DHAWAN.
Indian Agri. Res. Institute, JOGINDER SINGH.
New Delhi-12, *April* 14, 1961.

1. Chavan, V. M., Kelkar, S. G. and Bidari, P. G., *Curr. Sci.*, 1950, **19**, 156.
2. Negi, L. S. and Bahans, K. S., *Indian Fmg.*, 1957, **7**, 32.
3. Sprague, E. W., Dhawan, N. L. and House, L. R., *Curr. Sci.*, 1960, **29**, 295.
4. Andres, J. M. and Bascialli, P. C., *Inst. Genet. Fac. Agron. Vet.*, B. Aires, 1940, **1**, 20; (*P.B.A.*, **12**, 146).
5. Johnson, I. J. and Hayes, H. K., *J. Amer. Soc. Agron.*, 1940, **32**, 479.
6. Griffing, B. and Lindstrom, E. W., *Agron. J.*, 1954, **46**, 545.

EFFECT OF FLOWER SUPPRESSION AND GRAFTING ON NICOTINE CONTENT IN TOBACCO

Nicotiana tabacum is normally determinate in its growth and does not need any specific day-length for flowering. A recessive mutation termed "mammoth" characterised by indeterminate growth and short-day requirement for flowering has been isolated in *N. tabacum*.[1] This mutation has not been found in *N. rustica* but has been transferred to it from *N. tabacum* by hybridization and back-crossing.[1] The "mammoth" gene behaves as a temperature preceptor for flowering in a *N. rustica* genotype.[2] When grown at New Delhi during the summer months, mammoth plants do not flower. In order to ascertain whether genetic suppression of flowering has any effect on nicotine content, sun-dried samples of leaves (without petioles) from normal and "mammoth" plants derived from *rustica-tabacum* crosses were subjected to nicotine estimation by the spectrophotometric method.[3] Estimations were also carried out in one variety each of *N. tabacum* and *N. rustica* and in reciprocal grafts between them (in the grafts, the samples were taken from the scion). The *rustica-tabacum* hybrid derivatives segregating for the "mammoth" character had been obtained from Dr. H. H. Smith of the University of Cornell, United States. The parent varieties used in this cross were unfortunately not available. Ten samples were taken in each case and the average nicotine content in the different material is given in Table I.

TABLE I

Sl. No.	Material	Average nicotine content (%)
1	*N. rustica* var. N.P. 220 ..	1·56
2	*N. tabacum* var. Kwang ..	1·28
3	*N. rustica* × *N. tabacum* derivatives	
	(*a*) Normal ..	3·12
	(*b*) Mammoth ..	4·55
4	N.P. 220 on Kwang root stock ..	1·37
5	Kwang on N.P. 220 root stock ..	2·23

The data indicate that first, suppression of flowering increases nicotine content in tobacco and secondly the root stock influences the nicotine content of the scion. Thus, the *rustica-tabacum* "mammoths" have higher nicotine content in addition to being superior to the normal plants both in the number and size of leaves.

I am indebted to Dr. M. S. Swaminathan, Cytogeneticist, for suggesting this study and to Dr. C. Dakshinamurti, Senior Physicist, for advice and help in the spectrophotometric estimation of nicotine content.

Division of Botany, K. A. PATEL.
Indian Agricultural Research Institute,
New Delhi-12, *February* 27, 1961.

1. Smith, H. H., *J. Heredity*, 1950, **41**, 199.
2. Murty, B. R. and Swaminathan, M. S., *Euphytica*, 1957, **6**, 227.
3. Ramamurthy, B., Chatterjee, B. C., Dakshinamurti, C. and Gulati, K. C., *Nature*, 1952, **169**, 112.

VARIATION AMONG RICE VARIETIES IN REGARD TO GERMINATION UNDER SUBMERSION, AND HEAT STABILITY OF CHLOROPHYLL*

TWENTY varieties of rice (U.S.A.) were germinated in a 0·30 molar sucrose solution and 12 of these were later grouped into three classes: (1) drought resistant; (2) drought susceptible and (3) intermediate, based on their wilting behaviour in pot culture in the green house, by cutting off water-supply after 21 days' growth. Four varieties in each of the groups 1 and 2 above were further tested for underwater germination and coleoptile growth, and three varieties for heat stability of chlorophyll, modifying the method followed by Kaloyereas (1958) for pine varieties.

For under-water germination test, seeds were taken one month after harvest and two seeds in each variety were placed into a test-tube 15 cm. long and 1·5 cm. in diameter and water maintained at a depth of 8 cm. The length of coleoptile was measured on the fifth day. For chlorophyll test, leaves from 20 days' old seedlings and weighing 2 gm. in each variety were heated in water-bath at 56 ± 1° C. with 50 ml. of distilled water for one hour and 30 minutes. The leaves were then taken out and ground with 100 ml. of 80% acetone solution in water in a Waring blendor for two minutes, the contents filtered over glass wool and tested for light absorption in a Klett photoelectric colorimeter using a No. 66 red filter. The data are presented in Tables I and II.

TABLE I

Under-water germination—Length of coleoptile in cm. (Average of six measurements)

Group (1) Varieties		Group (2) Varieties	
Rex × Red ..	2·88	C.I. 6001 ..	1·05
Zenith ..	2·88	Early Prolific ..	1·75
Fortuna ..	2·90	Blue Rose ..	1·70
Blue Bonnet ..	3·25	Lacrosse ..	1·28
Average ..	2·98	Average ..	1·45

TABLE II

Colour readings obtained in chlorophyll extracts (Average of two readings)

Group (1)		Group (2)	
Rexoro ..	48·00	Early Prolific ..	98·25
Zenith ..	64·75	Blue Rose ..	99·75
Fortuna ..	48·50	Nato ..	96·00
Average ..	53·75	Average ..	98·00

The capacity of certain rice varieties for rapid germination and growth under submersion, as also their chlorophyll stability, would appear to be directly related to their resistance to drought in the initial stages of growth. Whether these indicate only a general type of resistance rather than a specific resistance to drought will be determined by undertaking more intensive studies with Indian varieties.

Rice Section, P. C. SAHADEVAN.
Central Farm,
Mannuthy, Trichur, *February* 22, 1961.

* Summarized from a *Thesis* submitted for the M.S. Degree of the Louisiana State University (U.S.A.) in January 1961. Investigations were carried out at the University Botany Laboratories, at Baton Rouge and at the Rice Experiment Station, Crowley.

1. Kaloyereas, S. A., "A new method of determining drought resistance," *Plant Physiol.*, 1958, **33**, 232.

REVIEWS

Theory of Differential Equations. By Andrew Russell Forsyth. Six volumes bound as three. (Dover Publications, Inc., New York). Price for the set $ 15.00.

The nineteenth century witnessed remarkable strides in pure mathematics and the theory of differential equations was the playground of some of the eminent mathematicians in the history of mathematics like Gauss, Hamilton, Jacobi, Cauchy, Lie, etc. In a monumental work that took over fifteen years to complete, Forsyth brought forth in six volumes every important development in the theory of differential equations that took place before the first decade of the present century. Forsyth himself has made several outstanding contributions to the subject and these volumes which cover over 2,500 pages represent one of the most comprehensive treatment of differential equations ever written. The publishers of the Dover series have now rendered a valuable service by reprinting these books which were out of print for a long time and bringing them in the form of three volumes that are beautifully bound and easy to handle.

Volumes I and II deal almost entirely with the functional character of the solutions of the ordinary differential equations, and give a good exposition of exact equations and Pfaff's problem. Volume III and IV deal with linear and non-linear equations, and Volumes V and VI cover the developments in the field of partial differential equations. V.

A Treatise on the Analytical Dynamics of Particles and Rigid Bodies. By E. T. Whittaker. (Cambridge University Press, London, N.W. 1), 1960. Pp. xiv + 456. Price 35 *sh.*

The present paper-bound edition is a reprint of the fourth edition that was released in the year 1937. Whittaker's work has been so popular amongst applied mathematicians and theoretical physicists that a detailed review of the contents of the book seems hardly to be necessary. The general opinion of the book is reflected in the following statement from a review on the book that appeared in the *Mathematical Gazette*. "It has become the standard work on the topics with which it deals". The present edition will be warmly welcomed by all mathematicians, physicists and engineers. V.

Statistical Thermodynamics. By Erwin Schrodinger. (Cambridge University Press, London, N.W. 1), 1960. Pp. 95. Price 8 *sh.* 6 d.

The book is a collection of the lectures delivered by Schrodinger at the School of Theoretical Physics, Dublin Institute, for advanced studies. The object of this course of seminar lectures is, in Professor Schrodinger's words, 'to develop briefly one simple unified standard method, capable of dealing, without changing the fundamental attitude, with all cases (classical, quantum, Bose-Einstein, Fermi-Dirac, etc.) and with every new problem that may arise. The interest is focused on the general procedure, and examples are dealt with as illustrations thereof. It is not a first introduction for newcomers to the subject, but rather a 'repetitorium'. The treatment of those topics which are to be found in every one of a hundred text-books is severely condensed, on the other hand, vital points which are usually passed over in all but the large monographs are dealt with at greater length.

The student's edition will be warmly welcomed by all physicists. V.

The Theory of Optics. By Paul Drude. Translated from the German by C. Riborf Mann and Robert A. Millikan. (Dover Publications, Inc., New York), 1959. Pp. xxi + 564. Paper-bound, Price $ 2.45.

As in literature so in science certain classics have an abiding value; the book under review belongs to this category. The appearance of Drude's treatise in the cheap paperback edition will be a great boon to students in India, especially as most modern books on the subject still compare unfavourably with it, as regards clarity of presentation. S. P.

Physics of the Atom. By M. R. Wehr and J. A. Richards, Jr. (Addison-Wesley Publishing Co., Reading, Mass, U.S.A.), 1960. Pp. xii + 420. Price $ 6.50.

This book presents an ideal introduction to modern physics and can be recommended to graduate students of Physics in Indian Universities. The twelve chapters of the book deal with the following main topics: Atomic views of matter, electricity, radiation, and solids; Rutherford-Bohr model of the atom; Relativity;

X-rays; Waves and corpuscles; Natural and artificial radioactivity, nuclear reactions and nuclear energy; Cosmic radiation and fundamental particles.

The topics have been chosen in a logical sequence, and in their presentation and development a chronological order has been followed. The special feature of the book is the informal style which the authors have used in writing. It reads like an across-the-table-talk (with a writing tablet in front to explain and drive home the point) between the teacher and the student, interspersed with many apt and illuminating analogies. The students while reading the book will experience no difficulty in understanding the new concepts involved in the growth of the subject to its present status. He will only be stimulated to go in for further detailed reading. This text-book "bridges the gap between classical physics and the new frontiers of physical investigations". A chronology of the atomic view of Nature, and a list of Nobel Prize winners in Physics and Chemistry are given at the end of the book.

A. S. G.

Reactor Handbook (Second Edition), Vol. I—*Materials*. Edited by C. R. Tipton, Jr. (Interscience Publishers, New York, London), 1960. Pp. 1223. Price $ 36.50.

This is the second edition of the *Reactor Handbook* prepared under contract with the United States Atomic Energy Commission. The first edition was published in 1955, and comprised of three volumes of total number of pages about 2,500. Those who have been using the first edition will have realised the indispensability of the volumes as a reference book on the subject and at the same time will be wishing for the publication of a new edition in which will be included all the latest developments that have taken place in Reactor Science and Technology. During the five years the growth in this field has been dramatic as will be clear not only from the, literally, thousands of publications but also from the number of international conferences and scientific meetings on atomic energy and allied subjects which have been held during the intervening period, the proceedings of many of which have come out in print. With such a large amount of bewildering data available the bringing out of a Handbook is itself a tremendous task. Add to this there is the difficulty that in a complex and ever changing field as the present one, many of the information compiled today may soon become out of date. Yet not only is a source-book on Reactor science a necessity, but it should be seen also that this information is rendered up to date as far as possible. In this context the Editors, the Review Board and the hundreds of contributors who will be making it possible for the second and expanded edition of the *Reactor Handbook* comprising of four volumes and a projected 3,500 pages to be brought out deserve the gratitude of all people connected with Reactor Engineering and Technology.

The volume under review is the first of the four volumes in the series and deals with *Materials*. The other volumes to be issued will be on *Fuel Reprocessing*, *Physics and Shielding*, and *Engineering* respectively.

The coverage in the present volume on Materials has been extended beyond that of the first edition to include liquids and gases, besides solids, and information on irradiation behaviour. The contents have been planned in a most rational way and the reactor materials have been taken up in the order of their functional utilization within the reactor. Thus the Fuel materials come first, followed by Cladding and Structural Materials, the Control Materials, the Moderator Materials, the Coolant Materials and, finally, the Shielding Materials.

The basic materials for reactor fuels are, of course, uranium, thorium and plutonium. But as they are totally inadequate for most reactor use, it is necessary to develop materials that contain them but have much different properties and have to fulfil stringent conditions. In the section on Fuel Materials there are separate chapters for uranium, thorium and plutonium, and their respective alloys. Each chapter deals with the preparation (or separation) of the fuel concerned, the heat treatment, the properties both physical and mechanical, corrosion effect and effect of irradiation. There is a chapter on ceramic or non-metallic fuels such as UO_2, UC, or UC_2 which are used either alone or in combination with other ceramics, as fuel element cores or as fuel grains dispersed in graphite, BeO or SiC matrix. There are also chapters on Dispersion Fuels, Liquid Metal Fuels, Aqueous Fuel Systems, and Molten Salts as Reactor Fuels.

The 130 contributors to this volume are all reactor scientists or engineers intimately engaged with the topic they are writing about. As such the information in each topic is practical and authoritative. The text is supplemented by a large number of graphs, illustrations and tables. The volume is brought out in two-column format in excellent print on heavy-

weight paper and the strong binding will withstand constant usage.

The publishers have indicated that the price for the complete set of four volumes will be about $ 80-90.

All Reactor establishments and research centres must possess a copy of this *Reactor Handbook* (Second Edition) and those who have anything to do with Reactor Science will find up-to-date and authoritative information in these volumes. A. S. G.

Mechanisms in Radiobiology, Volume II—*Multicellular Organisms*. Edited by Maurice Errera and Arne Forssberg. (Academic Press, New York and London; India: Asia Publishing House, Bombay-1), 1960. Pp. 395. Price $ 13.00.

The extraordinary rapid pace set in the development of atomic energy after the realisation of self-sustained fission reactions has closely been paralleled by the advancement of biology in general and radiobiology in particular. From shortly after the Second World War several attempts have been made by many national and international bodies as well as by groups of competent individuals to present a co-ordinated picture of the up-to-date progress in radiobiology. The unprecedented rate and volume of the pertinent publications in this field make it imperative that such attempts at a comprehensive integration be made at regular intervals to sieve the fast emerging data from various laboratories, to critically review them and to place them in their proper place and sequence. Editors Errera and Forssberg in their *Mechanisms in Radiobiology* have attempted such a comprehensive and up-to-date survey of the field of radiobiology and adjacent disciplines. In the volume under review (Volume II), radiation effects on embryonic and adult organisms (chiefly mammals) have been discussed. Eight contributors have written five chapters on the topics of their special competence. These are:—(1) General Biology: Gametes, the Developing Embryo and Cellular Differentiation, by Roberts Rugh; (2) General Biology: The Adult Organism, by Carl-John Clemedson and Arne Nelson; (3) Immunology, by Milan Hasek and Alena Lengerova; (4) Mechanisms of Protective and Sensitizing Action, by Lorentz Eldjarn and Alexander Pihl, and (5) Recovery and Therapy of the Irradiated Organism, by D. W. Van Bekkum. It is inevitable that the articles should vary in quality. Also, it must have been a very difficult decision for the editors to allot enough space for each particular topic, and for the contributors to decide what to include and what to exclude.

The first chapter by Rugh is impressive in its depth and extent, and the delineation of the areas where much still remains to be done has added to its intrinsic value. The second chapter on the adult organism, though extensive in its bibliography, has almost meticulously avoided the not too meagre available data on human beings and has not added much to the information already available in the excellent report of the United Nations Scientific Committee on the Effects of Atomic Radiation (1958). The concise chapter on immunology by Hasek and Lengerova is extremely stimulating specially where the most recent observations in the field have been critically reviewed and the open questions in the problem of radiation chimeras have been discussed. The remaining two chapters have also fairly extensively dealt with their respective topics and are well presented. It is probably impossible to avoid overlapping and repetitions during the review of closely allied and inter-linked scientific disciplines, especially when such reviews are attempted by different individuals or groups. This volume is no exception and such overlapping can be seen between chapters one and two as well as between chapters three and five. But to the credit of the editors, it must be admitted that in this volume they are extremely limited and by the very nature of the topics probably inevitable. The paper and printing on the whole is good, though a few typographical slips can be noted and some of the photo-micrographs might have been improved. This volume will be useful to research workers, students and others interested in radiobiology.

One drawback of such extensive reviews in successive different volumes of a fast expanding field of science (as the editors themselves foresaw it) is the quite sizable leeway left between the stage of planning and that of publication of the book. This has to be remembered while appreciating the observations and conclusions in the different chapters.

V. R. KHANOLKAR.

Methods of Biochemical Analysis, Vol. 8. Edited by D. Glick. (Interscience Publishers, New York), 1960. Pp. ix + 400. Price $ 10.00.

The eighth volume of *Methods of Biochemical Analysis* contains articles on some of the techniques of Biochemistry introduced in recent years, all contributed by specialists in their respective fields. Among the topics considered are Gas-Liquid Chromatography, Determination

of Neuraminic Acids and the Adaptation of Heatburst Microcalorimetry for the Accurate Determination of Thermodynamic Constants of Biochemical Reactions.

In the first article A. T. James describes the principles and apparatus used for the determination of fatty acids by gas-liquid chromatography. The extraction, saponification and esterification of lipids, the separation of short and long-chain fatty acids, the methods for their identification and quantitative determination and the various types of detectors which are in vogue, are dealt with in great detail.

In the second chapter, A. M. Chase reviews the extraction and purification procedures for the preparation of luciferases and luciferins from *Cypridine hilgendorfii* and from luminous bacteria like *Achromobacter fischeri*. After discussing the photographic methods, the use of photo-multiplier photometer and the light integrator employing a vacuum tube electrometer, the details of assay procedures are given and the applications of these bioluminescent systems for micro-determination of biologically important compounds like coenzyme A and ATP are clearly pointed out.

In recent years enzymes have, by virtue of their high catalytic activities, precise steric and positional specificity as well as high substrate affinities, assumed importance as analytical tools. Paul Talalay describes in this volume the use of purified hydroxysteroid dehydrogenases for the specific microestimation of steroid hormones and their metabolites.

J. E. Scott shows how the reaction with long chain quaternary ammonium compounds may be exploited for the isolation and fractionation of acid-polysaccharides. The author draws pointed attention to the wide applicability of these methods and visualises that principles based on charge density of the poly-electrolyte should find application in the resolution of borate complexes of the neutral polysaccharides.

Sialic acids have assumed prominence as components of mucoproteins and of certain lipopolysaccharides. Details of the methods of isolation and characterisation by infra-red X-ray crystallography and colorimetric estimation of these compounds are given by Whitehouse and Zilliken.

The multiplicity of naturally occurring porphyrins and their existence in isomeric forms have made their quantitative analysis extremely difficult and cumbersome. Schwartz, Berg, Bossenmaier and Dinsmore in their article on the determination of porphyrins in biological materials give a summary of the physico-chemical properties of these compounds which is followed by details of analytical procedures based on fluorimetry. Details of preparation of hemin, protoporphyrin, metalloporphyrins and porphobilinogen are also included.

The use of isolated pieces of frog skin for the quantitative determination of melanocyte-darkening and lightening agents is described by A. B. Lerner and M. R. Wright. The authors also give details of 'Single Response Balance Design Test' to correct for variation in response of skin specimens obtained from different frogs.

Particularly valuable to the physical biochemist is the last chapter on "Principle and Method of Heart Burst Microcalorimetry and the Determination of Free Energy, Enthalpy and Entropy Changes by C. Kitzinger and T. H. Benzinger. The novel principle of Heat Burst Microcalorimetry, the methods by which it can be adapted for routine work in biochemical laboratories and the instrumentation required are all explained with exemplary clarity.

At the end of each chapter there is a fairly extensive bibliography. A few printing errors are noticeable in pages 201, 295 and 306. However, the general get-up of this volume is excellent and as a compendium of analytical information, it should serve as a very valuable reference to research workers in Biochemistry.

P. S. SARMA.

Current Problems in Animal Behaviour. Edited by W. H. Thorpe and O. L. Zangwill. (Cambridge University Press, London, N.W. 1), 1961. Pp. xiv + 424. Price £ 2-5-0.

This is a collection of 14 essays with some introductory chapters by the editors. Most of the authors are students of animal behaviour, but some are human psychologists or physiologists, and they have some very pertinent things to say about animals. The field is rather restricted. There is, for example, no reference to the work of Lindauer on communication between bees, of Otto Köhler on counting by birds, of Konorski and Skinner on behaviour in general. The book is not a text-book, but reflects the interests of one particular group.

Many of the facts are interesting, important, and well presented. But most of the authors seem to assume that a mechanistic account of the brain, in which each part has a function, is possible, though Gregory asks some incisive questions about the hypothesis. As we cannot describe the electrical properties of a copper wire except in terms of its properties as a whole, it seems to the reviewer unlikely that we shall be more successful with the brain,

But the list of alternative explanations of Lashley's results given on p. 73 does not appear to include quantisation.

Many of the studies reported here, for example, those of Blest on protective displays in moths, of Crook on bird flock organization, of Hinde, Thorpe, and Vince, on learning capacity in birds of different ages, with special reference to recognition of parents, could have been done in India with no apparatus, and might very well give novel results if performed on Indian species. Indian workers wishing to study animal behaviour under laboratory rather field conditions would be well advised to read this book.

J. B. S. HALDANE.

Studies on *Physalia physalis* (L.).—Part 1. *Natural History and Morphology*. By A. K. Totton. Part 2. *Behaviour and Histology*, by G. O. Mackie. *"Discovery" Reports*, Vol. XXX, 1960, pp. 301-67 and 369-408. Issued by the National Institute of Oceanography. (University Press, Cambridge.) Price £ 3-10-0 net.

Physalia physalis, the Protuguese-man-of-war is an interesting animal known since long. The gulf extant in our knowledge of this animal becomes considerably narrowed when one studies the above two contributions by Totton and Mackie. The first part by Totton (who has already contributed considerably to our knowledge of the Siphonophores of the Indian Ocean, vide, *"Discovery" Rep.*, 1954, 27, 1-162) is on the *Natural History and Morphology* and the second part by Mackie on the *Behaviour and Histology*.

In the first part, in a short introduction, Totton explains why this jelly fish, *Physalia*, is known as Portuguese-man-of-war. The author gives a detailed account of the method adopted by him in his researches. This would be of considerable help to those engaged in the investigation of such delicate animals. The animal has also been studied *in situ* in the field. There is a welcome non-technical description of *Physalia* which serves as a fitting introduction to the succeeding technical account. The doubt regarding the existence of two species of *Physalia* is dispelled. The animal occurs in two forms, the right-handed and the left-handed and this aspect is also dealt with. The author has studied in the field the angle of drift, the rate of drift and the somersaulting phenomena of the animal in the open calm water when breeze is absent. Detailed information is supplied regarding the stinging powers and toxicology of the animal with a good number of examples. The author shows the animal to consist of a highly hypertrophied asexual larva acting as a nurse-carrier of other larvæ, the polyphs, and adults, the medusoid gonophores. The pattern of budding has been studied in considerable detail, right from a very early stage and well illustrated by photographs. Though details of sexual reproduction are unknown the author clears some confusion existing in this regard, *viz.*, that the so-called "male" gonophores are female and the "female" medusoids are nectophores not concerned in reproduction. The other points made are : the jelly polyphs are vestigial nectophores ; the basal ampullæ of the tentacles are homologous with the basigasters of gastrozooids of other siphonophores, their walls being filled with nematoblasts ; the gonophores and tentacles are more complex and probably highly evolved than in other cystonects ; egg-cells are located in bands in the ectoderm of female gonophores. The author has also given a list of points about the living animal still requiring elucidation.

The second part by Mackie deals with the Behaviour and Histology of *Physalia* and is complementary to the first part. The section on Histology, as the author himself states, is supplementary to Chun's account in the *Thier-Reich*. The methods employed should be a guide to workers on similar organisms. The author deals with the float and its response to wind, musculature, and the reaction of the tentacles, gastrozooids and other appendages to stimulation. After a short introduction to- and data regarding technique employed in- histological studies the author deals at length with the histology of the muscular system, the nervous system, the mesoglœa, gas-gland, nematocysts and digestive regions, thus contributing considerably to our knowledge on these aspects. The author has recorded 20 ($2n$) chromosomes during mitosis.

Both the accounts are well presented with a review of earlier relevant literature, illustrated by several figures and a large number of excellent photographs. They also contain at the end a comprehensive bibliography. One error was noticed, *viz.*, in the citation of Totton and Mackie, 1956, on page 407 the concerned *locus* of publication should be *Nature*, 177, 290, and not *Nature*, 178, 1476-77. Both the authors and publishers are to be congratulated in bringing out such an excellent piece of research work. The volume should find a place in all institutions, where biology is taught.

R. SUBRAHMANYAN.

Qualitative Organic Analysis. By B. Haynes. (Cleaver Hume Press, 31, Wrights' Lane, Kensington, London, W. 8), 1961. Pp. 239. Price 17 *sh.* 6 *d.*

As the title implies, the volume under review deals exclusively with *qualitative* analysis of organic compounds. Preparation of compounds of synthetic value or quantitative methods of analysis are not included.

Divided into five parts, the book deals with preliminary examination, classification, separation of mixtures and identification of the components by preparation of derivatives. Tables of melting-points and boiling-points of most common organic compounds encountered in class-room work are given. A useful appendix for the preparation of standard analytical reagents is also provided. Qualitative tests are well emphasised with their limitations while points of technique are clearly brought out. Original references are given for a large number of procedures for preparing derivatives. Some of these are to quite recent publications.

The book is well got up, has an attractive laboratory note-book appearance and is free of errors. For undergraduate qualitative organic work the book is warmly recommended.

B. S. T.

Biological Activities of Steroids in Relation to Cancer. Edited by Gregory Pincus and Erwin P. Vollmer. (Academic Press, New York and London), 1960. Pp. xii + 530. Price $ 15.00.

This book represents the record of the proceedings of a Conference on "Biological Activities of Steroids in Relation to Cancer" sponsored by the Cancer Chemotherapy National Service Centre, National Cancer Institute, National Institutes of Health, U.S. Department of Health, Education and Welfare, held at Vergennes, Vermont, on October 2nd, 1959.

The papers presented at the symposium have been brought together under five broad groups. The first, serving as introduction, contains one paper on "Steroids, Growth and Cancer". The second group contains two papers on the subject of "Steroid Structure and Function". The third group contains ten papers on the subject of "Steroid Metabolism and Biochemistry". The fourth group contains five papers dealing with the problem of "Steroid and Experimental Tumours". The fifth group contains fourteen papers on the subject of "Hormones and Human Cancer". As mentioned by the editors in the preface to the book "These meetings did not lead directly to solutions and had not been expected to do so. If there was any consensus, it was more a postulate than a conclusion, that the role of steroids in tumour genesis, growth and regression involves more than a simple drug-target tissue relationship".

The editors deserve to be congratulated on the uniformity of presentation achieved and in bringing together the work done by many distinguished scientists in the field. The publication will, doubtless, prove of great value to research workers in the field of cancer.

M. SWAMINATHAN.

The Thyroid Gland, *British Medical Bulletin,* Vol. 16, No. 2. (The Medical Department, The British Council, 65, Davies Street, London, W. 1), May 1960. Pp. 89-174. Price 20 *sh.*

The application of the newer techniques of chromatography and the radioactive isotope tracer studies, during the last ten years, has considerably advanced our knowledge of the function of the Thyroid gland.

The detection of the natural occurrence of tri-iodothyroxine and the development of the concept that thyroxine is not the only hormone but is one of a family of iodine containing amino-acids secreted by the thyroid is a fundamental observation of great importance. Discovery of two types of antithyroid drugs, those like thiocyanate and perchlorate inhibiting the thyroidal iodine concentrating mechanism; and thiourea and related compounds allowing iodine concentration but preventing its incorporation into organic compounds, has given some insight into the biosynthesis of the thyroid hormones.

The nature, distribution and properties of thyroxine binding protein, and its influence on clinical disorders has brought to the forefront the importance of the study of the hormonal transport mechanisms. The role of these binding substances in the two-way distribution of the hormone, between the mother and the fœtus during embryogenesis and fœtal development has attracted considerable attention.

Recent researches have thrown considerable light on the production, actions, assay and uses of the thyroid stimulating hormone.

Genetic aspect of diseases is a conspicuous feature of modern medical research. The familiar incidence of thyroid disease, methods of inheritance, congenital deafness and goitre and utilisation of 'taste blindness' to phenylthicarbomide as a means to determine the type of goitre, present definite advances in our knowledge of thyroid disease.

Another striking discovery in the field of thyroid research is the demonstration of the formation of thyroid auto-antibodies. The implication of this observation in the wider immunological problem, in general, needs no emphasis.

This monograph, besides discussing the topics referred to above, also presents many other specialised aspects of thyroid research highly useful to biochemists and clinicians.

M. SIRSI.

The Tenth Symposium of the Society for General Microbiology—Microbial Genetics. Edited by W. Hayes and R. C. Clowes. (Cambridge University Press, London, N.U. 1), 1960. Pp. 300. Price 42 *sh.*

The coming of age of *Microbial Genetics*, the most fundamental of biological sciences, was heralded by the discussion of many of its ramifications at the Tenth Symposium of the Society for General Microbiology. Biochemical Genetics of fungi started some two decades ago, when gradually extended to bacteria, became complex and its techniques "esoteric". This was not very surprising since recombination of genes occurring as a consequence of sexual reproduction in higher organisms is achieved in bacteria by a variety of mechanisms. Phenomena reminiscent of sexual reproduction occurs in *Escherichia coli*. But recombination of genes is also achieved by infection or "contagion". What is more, bacterial genes could be transferred either by phages or even as naked desoxyribose nucleic acid. These transmissible heritable agents in bacteria are now referred to as "Episomes", since they may be added to or lost from a bacterial genome and may remain autonomous or get integrated into the bacterial chromosomes.

The importance of desoxyribose nucleic acid as the site of genetic information has led to the development of Molecular Genetics which attempts to elucidate the physico-chemical structure of the genetic material. The last field of endeavour, started barely eight years ago, is legitimized by its inclusion in the Symposium.

The volume deals with a "complex and esoteric discipline". But it should be of interest to a wide circle of readers since some of the important discoveries in the subject were made by interlopers into that field!

M. K. S.

Books Received

From: (Academic Press Inc., Pub., 111, Fifth Avenue, New York-3; India: Asia Publishing House, Nicol Road, Bombay-1):—

International Review of Tropical Medicine (Vol. I). Edited by David Richard, Lincicome, 1961. Pp. xii + 300.

Pure and Applied Mathematics, Vol. IX—*Solution of Equations and Systems of Equations*. By A. M. Ostrowski, 1960. Pp. ix + 202. Price $ 6.80.

Solid State Physics (Vol. XI)—*Advances in Research and Applications*. Edited by Frederic Seitz and David Turnbull, 1960. Pp. xvi + 438. Price $ 12.50.

Advances in Catalysis and Related Subjects, Vol. XII. Edited by D. D. Eley, P. W. Selwood, and P. B. Weisz, 1960. Pp. x + 324. Price $ 11.00.

The Nucleic Acids (Vol. III). Edited by A. G. Norman, 1960. Pp. xi + 464. Price $ 12.50.

From: (Cambridge University Press, London, N.W. 1):—

A Second Course in Statistics. By Robert Loveday, 1961. Pp. xi + 155. Price 10 *sh.*

Radiowaves in the Ionosphere—The Mathematical Theory of the Reflection of Radiowaves from Stratified Ionised Layers. By K. G. Budden, 1961. Pp. xxiv + 542. Price 95 *sh.*

Numerical Methods of Curve of Fitting. By P. G. Guest, 1961. Pp. xiv + 422. Price 80 *sh.*

From: (Interscience Publishers, Inc., 250 Fifth Avenue, New York 1).

Treatise on Analytical Chemistry—A Comprehensive Account in Three Parts—Vol. 2, Part I—*Theory and Practice*. By I. M. Kolthoff and Philip J. Elving, 1961. Pp. xx + 1308. Price $ 16.00.

Basic Principles of Fission Reactors. By W. R. Harper, 1961. Pp. viii + 314. Price $ 7.50.

Introduction to the Theory of Ionized Gases. By J. L. Delcroix, 1960. Pp. xi + 149. Price: Cloth bound $ 3.40, Paper bound $ 2.50.

Physics and Archæology. By M. J. Aitken, 1961. Pp. x + 181. Price $ 6.00.

The Chemistry of Heterocyclic Compounds (Vol. XIV). Edited by Erwin Klingsberg—*Pyridine and its Derivatives*, Part II, 1961. Pp. x + 576, Price $ 37.50, Subn. $ 32.50.

SCIENCE NOTES AND NEWS

Award of Research Degree

Andhra University has awarded the D.Sc. Degree in Nuclear Physics and Chemistry to Messrs. M. Ramakrishna Raju and K. S. Venkateswarlu for their theses entitled "Studies in Beta Absorption" and "Kinetics of Annealing of Radiation Damage in Cobalt Complexes—Tris acetyl acetone Co (iii)" respectively.

Osmania University has awarded the Ph.D. Degree in Chemistry to Messrs. K. Ramaiah and Wajid Ali Khan for their theses entitled "Studies on Some Heterocyclic N-Oxides in Pyridine and Quinoline Series" and "Chemical Investigation of Plant Insecticides, Structural Studies of Scandenin and Related Compounds" respectively.

Lady Tata Memorial Trust Scholarships and Grants for the Year 1961-62

The Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Derabji Tata, 18th June 1961, the awards of scholarships and grants for the year 1961-62.

International Awards of varying amounts (totalling £ 4,350) for research in diseases of the blood with special reference to Leucaemias are made to: Dr. (Miss) B. M. Braganca (India); Dr. L. Chieco-Bianchi (Italy); Dr. H. J. Woodliff (England); Drs. Amiel and Mathe (France); Dr. G. Wynne Griffith (Great Britain); Dr. B. Lagerlof (Sweden).

Indian Scholarships of Rs. 250/- per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to: Miss M. Indira (Bangalore); Mr. V. S. Rao (Hyderabad); Mr. A. K. Ray (Calcutta); Mr. S. K. Sankarappa (Madras); Mr. V. N. Gogte (Bombay); Dr. (Mrs.) Saroj Mehta (New Delhi); Dr. R. K. Panja (Calcutta).

Conference on Building Research

The Third Conference of Building Research Workers will be held at the Central Building Research Institute, Roorkee (U.P.), on 13th and 14th November, 1961 and will devote its attention to those aspects of building design and construction generally referred to as "Functional Efficiency".

The following topics will be discussed: (a) The effect of climate on building design in the Tropics; (b) Thermal comfort in buildings (including ventilation, natural and artificial), air-conditioning, performance of building component; (c) Acoustics of buildings (acoustical properties of materials, noise and related topics); (d) Lighting in buildings (natural and artificial); (e) Testing and standardisation of thermal and acoustical materials.

Papers on subjects mentioned above are invited. The last dates for receipt of abstract of papers is 15th July 1961 and the finalised paper 15th August 1961.

Further information on the above Conference can be had from the Director, C.B.R.I., Roorkee.

Symposium on 'Production and Utilization of Medical and Aromatic Plants in India'

A symposium on the above subject will be held at the Regional Research Laboratory, Jammu and Kashmir, on 27th and 28th November, 1961.

Intending participants at the symposium are requested to send brief abstracts of their papers by August 15, 1961. Complete papers should be sent by September 15, 1961.

Further particulars can be had from Dr. I. C. Chopra, Deputy Director, Regional Research Laboratory, Canal Road, Jammu Tawi.

All-India Cancer Conference

Under the sponsorship of the Indian Cancer Society, it is proposed to hold the First All-India Cancer Conference on 8th, 9th and 10th December, 1961, at Bombay. Scientific papers on tumours and related problems are invited. The last date for sending the abstracts is 30th September 1961.

The Organizers are approaching the Railway Board to sanction Railway concession for delegates attending the Congress. Failing this, they shall bear all the lodging and boarding expenses of the delegates whose papers are accepted.

Further particulars can be had from the Honorary Secretary, Dr. D. J. Jussawalla, Indian Cancer Society, and Convener, First All-India Cancer Conference, Hospital Avenue, Parel, Bombay-12.

First European Malacological Congress

Under the auspices of the Conchological Society of Great Britain and Ireland and the Malacological Society of London it is proposed

to hold the First European Malacological Congress in London, from 17th to 21st of September, 1962.

The object of the Congress is to discuss all aspects of European Malacology and the formation of a European Malacological Union. The Congress is, however, open to all interested in Malacology from any part of the world.

The programme will include Scientific Meetings and Field Meetings. Enquiries should be addressed to the Hon. Secretary, Rev. H. E. J. Biggs, 19, Siward Road, Bromley, Kent. The Hon. Treasurer is J. F. Peake Esq., British Museum (Natural History), Cromwell Road, London, S.W 7.

Root-Parasite—*Aeginetia indica* Linn.

With reference to the note on the above subject by Chavan *et al.* (*Curr. Sci.*, May 1961, p. 191), Shri R. S. Rao, Regional Botanist, Botanical Survey of India, Western Circle, Poona, writes: "While working on the flora of Tripura State during August 1957, I had come across small patches of *Aeginetia indica* Linn. growing profusely in small clumps along the dark humid corners in one area of Cherilam Reserve Forest which is near Agartala. In view of the absence of definite information about the host plant of this complete root-parasite, a careful search was made to trace the host roots in that area where the soil is quite soft, but no distinct host root could be located. I am however quite sure that no *Dioscorea* climbers were growing round about that area. It is therefore evident that this root-parasite grows on other hosts also and it is cosmopolitan in its nature of parasitism".

Atmosphere Temperature Fluctuations

The subject of climatic change is one which has for long interested climatologists and meteorologists, but especially so during recent years. Direct temperature observations, the recession of glaciers, the movements of fish and insects northwards in the northern hemisphere, as well as a similar movement of the tree-line have all indicated an appreciable rise in atmospheric temperature in many parts of the world during the past few decades. A recent contribution to the subject has been made by G. S. Callendar of the Ministry of Aviation, in a paper which appears in the *Quarterly Journal of the Royal Meteorological Society* (87, No. 371; January 1961). From his analysis he concludes that the rising trend is significant from the Arctic to about 45° S. lat., but is small and indeed locally non-apparent in regions below 35° N. as yet. A number of theories to account for the rise have been advanced, and there has been much speculation as to whether or for how long it will continue. One widely held theory is to the effect that the rising trend is a result of increased incoming solar radiation, due either to an increased output of solar energy or to an increased atmospheric transparency resulting from a decrease in volcanic activity. Callendar considers that such a hypothesis is not inconsistent with the observed zonal short-period fluctuations, but that it fails to explain the pattern of the overall climatic trend. The latter is considered to be not incompatible with the increased carbon dioxide theory, which is to the effect that the trend could be due to back radiation from the additional carbon dioxide produced by fossil-fuel combustion. The points at issue seem to be: Does Nature control the whole process or has human activity caused the trend, on which Nature has merely imposed the fluctuations?

Use of Superconductors for Producing Strong Magnetic Fields

The production of strong magnetic fields by the use of superconductivity phenomena would appear to be considerably advanced by the development of a new superconducting compound of niobium and tin, Nb_3Sn, by the Bell Telephone Laboratories. The distinctive property of this material is its ability to retain superconducting properties even when exposed to fields of about 90,000 œrsteds, and possibly even higher, while carrying currents of approximately 100,000 amp. cm.$^{-2}$ (*see* Kunzler *et al.*, *Phys. Rev.*, Letters for February 1, 1961). The new material is very brittle, but by packing a narrow niobium tube with appropriate quantities of powdered niobium and tin, sealing the ends of the tube with niobium plugs, reducing the tube by swaging and drawing it, a wire of 0·015 inch diameter which can be wound into a solenoid coil is formed. On heating the wire to about 1,000° C., the inner materials react to form Nb_3Sn, and the necessary superconducting properties are developed. Owing to mechanical difficulties associated with the substance at high fields, a large solenoid of the material has not yet been wound, but it is anticipated that these difficulties will be overcome within the next twelve months.—(*Nature*, 1961, 190, 134.)

Space Radio Telescope

Low-frequency electromagnetic radiations emitted by distant radio stars and galaxies cannot be studied by terrestrial radio telescopes because such frequencies are not transmitted

by the ionosphere of the earth. One possible method of studying this part of the cosmic radio spectrum will be by means of radio telescopes sent to heights above the earth's ionosphere. This was achieved for the first time when on January 7, 1961 a team of workers of the Harvard College Observatory launched, from their experimental base at Cape Canaveral, a rocket called Blue Scout which lifted radio telescopes above the earth's ionosphere.

As the rocket arc'd above the ionosphere, four small radio telescopes broadcast back to earth measurements of low-frequency cosmic radio noise. Each radio telescope was composed of a transistorized receiver, the size of a pocket radio, and a collapsed antenna which extends on command to a length of ten feet. The total weight of the four radio telescopes was less than 10 lb. They operated at frequencies between 700 Kc. and 13 Mc. A preliminary study indicated that all the four telescopes had operated successfully throughout the flight in space. Space radio telescope technique shows promise of getting new information about cosmic radiations that originated thousands of light years away, about the weak magnetic fields in interstellar space, the proton and electron clouds between the sun and the earth, the radio noise storms in Jupiter, etc.

The radio telescopes in the Blue Scout rocket were also used to conduct a new measurement on the earth's ionosphere. A group under this project with operations centred at San Salvador Island, sent high-powered coded radio pulses toward the ionosphere during the rocket's flight. Most low-frequency radiation is reflected back to the earth by the ionosphere. However, it has been generally suspected that the ionosphere shell may have small "holes", through which a small fraction of the terrestrial radio energy could leak. With the combination of the space radio telescopes and the San Salvador transmitters, the Harvard group has a new technique for studying the ionosphere and the leakage of terrestrial radiation into space.—(*Jour. Frank. Inst.*, 1961 271, 241.)

Plasma Diode

Plasma diode is a promising thermionic converter for use in nuclear reactors. The device utilizes the tremendous heat produced in the centre of nuclear reactor-fuel elements for the direct generation of electricity without the necessity for mechanical rotating equipment.

A thermionic converter produces an electric current by boiling electrons off a cathode, or hot metal plate, and collecting them on an anode, a cooler plate. The application of this technique to conventional steam-generating stations is not practicable, since the temperature levels to be had in such stations are too low to permit efficient operation of direct conversion devices.

The plasma diode under development at the General Electric is a high-temperature thermionic device using cæsium gas and a uranium-bearing cathode. These diodes would be built into nuclear fuel elements where the fissioning of the uranium in the cathode would provide the high temperatures—in the range 4,500° F.—needed for efficient direct conversion. An electrical lead from the fuel element would draw off the electricity.

In addition to the directly produced electricity, lower temperature heat rejected through the walls of the element would also be used to produce steam for operation of turbine generators.

Although thermionic conversion devices capable of producing approximately 20 watts per square centimetre of cathode area have been demonstrated, present thermionic converters are still a long way from approaching practical application. Recent design advances at the General Electric, however, give hope that they can have an advanced plasma diode ready to be installed in a thermionic fuel element and tested in a prototype nuclear power plant within five years.—(*Jour. Frank. Inst.*, 1961, 271, 247.)

Carbonaceous Meteorites

Meteorites are generally classified into the following three groups according to their composition: (1) Iron meteorites containing mostly iron (more than 90%) with nickel 8-9%, and traces of cobalt, about 0·5%; (2) Iron-stone meteorites whose average composition is 50% nickel-iron, and 50% iron-magnesium silicates (generally olivine, and occasionally with some pyroxene) and (3) Stone meteorites which show a great variety of composition and are mostly composed of olivine and pyroxene, with 5-20% Ni-Fe, about 5% troilite and about 10% plagioclase. To these may be added a fourth group, the tektites which are small glassy bodies found in isolated areas, but because no one has actually seen one fall, their classification as meteorites is still a subject of controversy.

Carbonaceous meteorites although they come in the group of stone meteorites are remarkably different from the rest. "They contain 1-5% of free carbon, which gives them a black sooty appearance, and 10-20% combined water, which no other meteorites have. They also contain

organic compounds in small amounts, as well as free sulphur, and calcium and magnesium sulphates. Instead of olivine and pyroxene, their silicate mineral is largely serpentine. They contain no nickel-iron. Only nineteen carbonaceous meteorites are known: all of them were seen to fall and were picked up soon after."

Interest in the study of carbonaceous meteorites has increased in recent years because of the significant information it leads to regarding the origin of life in planetary bodies other than the earth. Thus Nagy *et al.* using mass spectrographic method found that the fractional distillate obtained at 250-400° C., of the carbonaceous material of the Orgeuil meteorite, consisted of paraffinoid hydrocarbons of carbon numbers ranging from 15 to 24 with peaks at 18 and 23 carbon atoms. The analysis also showed presence of some cycloparaffins. They find that this distribution is largely similar to that found by them (using the same apparatus), for example, for butter or for organic materials in sediments. They conclude from this that "biogenic processes occur and that living forms exist in regions of the universe beyond the earth".

Taking for granted that the original material did contain paraffinoid elements similar to those produced in living matter, the question still remains to be determined whether they were produced by some form of life or by wholly inorganic processes.

If the material is derived from life, this must have occurred on the planetary parent body from which meteorites have been derived by fragmentation. The general consensus of opinion is that meteoritic parent bodies appear to be located in the asteroid belt between Mars and Jupiter. However, in this region the mean surface temperatures have been shown to be about — 50° C. This would not appear to permit liquid water and hence any chemical evolution. Further, even if hot enough they would not be large enough to hold water vapour gravitationally and, therefore, would be dry bodies like the Moon.

Prof. J. D. Bernal offers a novel suggestion (*Nature*, 1961, 190, 130): "The only likely place for the genesis of such hydrocarbons would be a planet the size of earth at about the same distance from the Sun. Why not the Earth itself, if we are not allowed any longer to postulate, Pythagoras' anti-Earth? The Orgeuil meteorite would then be a piece of primitive Earth shot off some hundreds of millions of years ago and again united to its parent body. Even more fanciful would be the idea that the stone derives from an earth-like planet of another solar system."

Radio Location Studies of Venus

Radio location studies of Venus were carried out recently in the USSR, when the planet was closest to the Earth (about 40 million kilometres). A wave in the middle of the decimetre band was chosen for these studies. The output of power sent from the Earth was 250 megawatts per steradian so that approximately 15 watts got to all visible surface of Venus. The emitted signal had circular polarization. The aerial with linear polarization was used for reception.

Preliminary results have led to establish a more precise value of the astronomical unit (the average distance between the Earth and the Sun) which is found to be 149,457,000 kilometres. Analysis of the radio signal reflected from Venus showed a widening of the frequency spectrum caused by the rotation of the planet. Measurement of this widening gave the period of rotation of Venus about its own axis as about 10 days. Zones with different coefficients of reflection of radiowaves were discovered on the surface of the planet.

Processing of the data continues and it is expected that the full results will be published soon.—(*Soviet News.*)

U.S. Project Mohole

The National Academy of Sciences and the National Science Foundation announced recently that the experimental drilling ship, *Cuss I*, operating in 12,000 ft. of water off the west coast of Mexico in the Project Mohole, obtained, for the first time, a sample of the so-called second layer under the softer sediments of the ocean floor. This layer, the presence of which has been previously known only by reflexions of seismic soundings, has been revealed as basalt. This hole, which was begun at Guadalupe Island on March 31, reached a depth of 490 ft. after 11 hr. of drilling. Coring then began, and cores of soft, grey-green clay of Miocene age were obtained to a depth of 560 ft. At that depth the drilling-rate abruptly decreased and when the core barrel was retrieved, it was found to contain a hard fine-grained basalt; the drilling had achieved threshold to the sima—(*Nature*, 1961, 190, 393.)

364-61. Printed at The Bangalore Press, Bangalore City, by T. K. Balakrishnan, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.

All material intended for publication and books for review should be addressed to the Editor, *Current Science*, Raman Research Institute, Bangalore-6.

Business correspondence, remittances, subscriptions, advertisements, exchange journals, etc., should be addressed to the Manager, Current Science Association, Bangalore-6.

Subscription Rates: India: Rs. 12-00. Foreign: Rs. 16-00; £ 1-4-0; $ 4.00.

ORGANIC CHEMISTRY

Revised Edition

By P. B. SARKAR, D.Sc., F.N.I.

Director of Technological Research
Indian Central Jute Committee

First Published 1942 — 10th Ed. 1960

500 pp. — Medium 8 vo — **Rs. 9**

"Excellent not only in its contents but in its get-up as well. I have no hesitation to call it the ideal book for B.Sc. students."

PROF. S. NAGARAJAN
R.D.M. College, Sivaganga

GENERAL PHYSICS

By T. M. MANDAL, M.Sc.

Late Professor of Physics, Vidyasagar College Calcutta

pp. 262. — *13 Edition, 1960* — **Rs. 6**

An up-to-date standard work for 3-year degree course. Worked out numerical examples and university questions. Thorough treatment in lucid style.

INTERMEDIATE CHEMISTRY

By P. K. DUTT

Professor of Chemistry, Presidency College Calcutta

pp. 672. — *7th Edition, 1959* — **Rs. 8**

A complete course with up-to-date information. Clear presentation. Covers all-India Higher Secondary and University syllabuses, with organic chemistry.

INORGANIC CHEMISTRY

(for 3-year Degree Course)

By A. K. DE, M.Sc., D.PHIL.

Reader in Chemistry, Jadavpur University

pp. 563. — Demy 8 vo — **Rs. 11**

"Well planned, up-to-date, and well presented."

PROF. P. M. BARVE
Wilson College, Bombay

A TEXT-BOOK OF HEAT

(for Junior Students)

By M. N. SAHA, D.Sc., F.R.S.

AND

B. N. SRIVASTAVA, D.Sc., F.N.I.

Prof. of Physics, Indian Association for the Cultivation of Science, Calcutta

pp. 357 — *10th Edition, 1959* — **Rs. 9**

Do. 1960 *(in Hindi)* — **Rs. 9**

The most popular book on the subject, fully covers the B.Sc. course of Indian and Pakistan universities.

ELEMENTARY PHYSICAL CHEMISTRY

By SANTI R. PALIT, D.Sc., F.R.I.C., F.N.I.

Prof. of Physical Chemistry, Indian Association for the Cultivation of Science Calcutta

pp. 421. — *12th Edition, 1960* — **Rs. 7·50**

A revised, enlarged and up-to-date text for pass B.Sc. students of Indian and Pakistan universities.

A TEXT-BOOK OF SOUND

By T. M. MANDAL, M.Sc.

Late Professor of Physics, Vidyasagar College Calcutta

pp. 282. — *8th Edition, 1960* — **Rs. 5·50**

A popular text for pass B.Sc. course for Indian and Pakistan universities. Exposition precise and simple.

DIFFERENTIAL CALCULUS

(for pass B.Sc.)

By B. S. RAY, M.Sc., PH.D. (Gottingen)

Lecturer in Applied Math., Calcutta University

"Well written, an excellent first course."
The Mathematics Student, Madras.

PRACTICAL CHEMISTRY

(for pass B.Sc. Course)

By B. K. GOSWAMI, M.Sc.

Lecturer in Chemistry, Jadavpur University

Inorganic, pp. 284. — **Rs. 5**

Organic, pp. 201. — **Rs. 4**

All essential details against theoretical background. A dependable guide.

SCIENCE BOOK AGENCY

P-133 B, LAKE TERRACE, CALCUTTA-29

FOR
ACCURACY
AND
DEPENDABILITY
in
CHEMICAL ANALYSIS & RESEARCH
use
laboratory reagents and guaranteed reagents
Manufactured by

SARABHAI MERCK PVT. LTD.
In conjunction with E. MERCK A.G. Darmstadt, Germany
Sarabhai Merck Pvt. Ltd., 13 Wittet Road, Bombay-1.
shilpi-s.m. 381

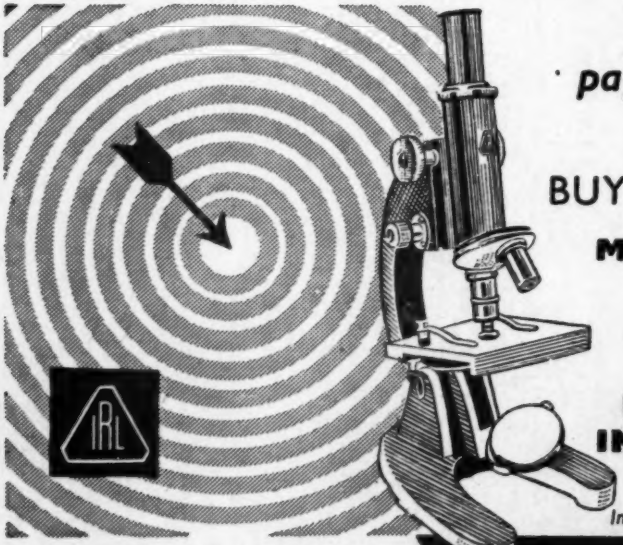
Hydrochloric Acid
(Analytical Reagent)

Sp. gr. ..... abt. 1·18

Max. limit of impurities

Non-volatile matter..... 0·001%
Sulphate..... 0·003%
Heavy metal..... 0·002%

THE
INTERNATIONAL CHEMICAL
INDUSTRIES
103-B, UPPER CIRCULAR ROAD
CALCUTTA-9



pay for precision

BUY IRL PRODUCTS
MICROSCOPES
and
PRECISION
OPTICAL
MEASURING
INSTRUMENTS

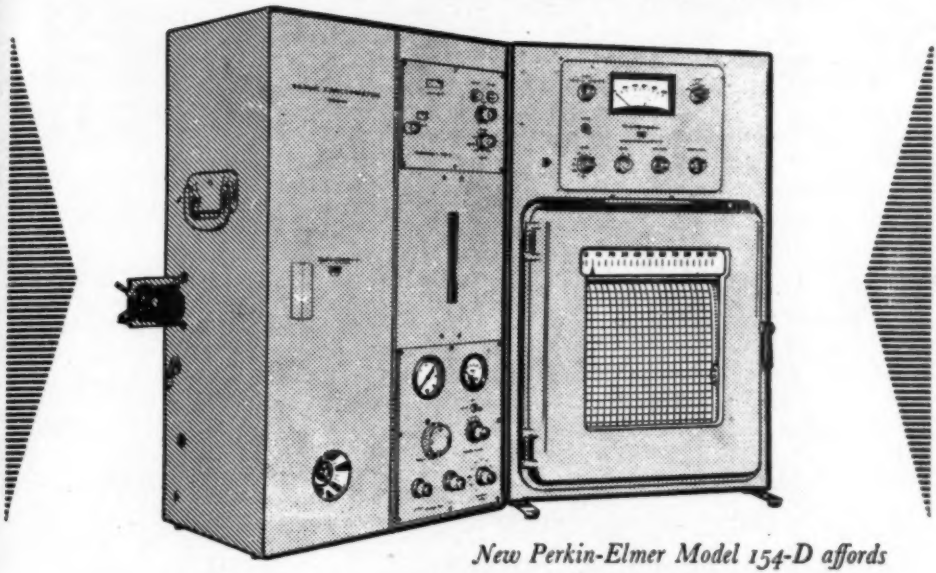
India's Leading Manufacturers

Sole Selling Agents
MERCANTILE UNION PRIVATE LTD.
309, Bepin Behary Ganguly Street, Calcutta 12
Phone : 22-5779

INSTRUMENT RESEARCH
LABORATORY LTD. CALCUTTA.

NA IRL-3-(

Now—HANDLE ANY PROBLEM IN GAS CHROMATOGRAPHY WITH ONE INSTRUMENT



New Perkin-Elmer Model 154-D affords greater range and flexibility in choice of sampling, separation, detection and measurement than any other instrument

Improvements come fast and furious in gas chromatography. Columns, detectors, sampling techniques, recorders have all been modified considerably—and new ones developed—since Perkin-Elmer introduced the the first commercial vapor fractometer 6 years ago.

FEATURES

- Flame ionization, thermistor, and hot-wire detectors—use singly or in combination.
- Golay (capillary) or packed columns (22)—use singly or in *parallel*.
- Micro-condensor, micro-reactor accessories for special studies.
- High-volume preparative columns for pure components.
- Automatic sample splitting for micro and macro quantities.
- Model 194 Printing Integrator for automatic printed integration of chart peak areas.

As your analytical problems become more complex, you have the assurance that this instrument has the capability to handle them. Its basic design makes it completely compatible with the widest range of accessories.

INSTRUMENT DIVISION
Perkin-Elmer *Corporation*
NORWALK, CONNECTICUT

Sold and serviced in India exclusively by

BLUE STAR

BLUE STAR ENGINEERING CO. (Bombay) Private LTD.
LOTUS COURT
JAMSHEDJI TATA ROAD, BOMBAY 1
Also at CALCUTTA · DELHI · MADRAS

PSBS-PE 71/61

INJECTABLES — Safe and Dependable

TRADE MARK

A wide range of parenteral preparations for meeting the growing requirements of the Medical Profession are now being processed in our Laboratories. They are made from Standard Chemicals employing double distilled and PYROGEN FREE water. Their containers (Ampoules) undergo rigid neutrality tests before they are selected for use. These Injectables are therefore guaranteed to be absolutely safe and dependable.

The following are but a few of our well-known Injectables :

- RETICULIN .. .. .. A Potent extract of Liver
- HEXOPURIN .. .. .. An urinary Antiseptic
- CALCITOL .. .. .. Injectable Calcium Gluconate
- BEVITAMIN .. .. .. „ Vitamin B_1
- CEVITAMIN .. .. .. „ Vitamin C
- GLUCOSE SOLN. .. .. .. „ Pure Dextrose

The Mysore Industrial & Testing Laboratory Ltd.

Malleswaram P.O., Bangalore 3

Bengal Chemical and Pharmaceutical Works, Ltd.

The Largest Chemical Works in India

Manufacturers of Pharmaceutical Drugs, Indigenous Medicines, Perfumery, Toilet and Medicinal Soaps, Surgical Dressings, Sera and Vaccines, Disinfectants, Tar Products, Road Dressing Materials, etc.

Ether, Mineral Acids, Ammonia, Alum, Ferro-Alum, Aluminium Sulphate, Sulphate of Magnesium, Ferri Sulph., Caffeine and various other Pharmaceutical and Research Chemicals.

Surgical sterilizers, Distilled Water Stills, Operation Tables, Instrument Cabinets and other Hospital Accessories.

Chemical Balance, Scientific Apparatus for Laboratories and Schools and Colleges, Gas and Water Cocks for Laboratory use, Gas Plants, Laboratory Furniture and Fittings.

Fire Extinguishers, Printing Inks.

Office: **6, GANESH CHUNDER AVENUE, CALCUTTA-13**

Factories: **CALCUTTA - BOMBAY - KANPUR**

INSIST ON

"QUICO"

PRODUCTS

"QUICO"

WATER-BATH

Electrically heated from 220/230 volts AC/DC universal mains, fitted with self-ejection type immersion heater to avoid burnouts of the apparatus, if accidentally boiling pan works dry. The bath is made of hard-rolled copper sheet, tinned inside & outside duly, painted grey, fitted with constant level arrangement and concentric rings, complete with plug and cord for direct connections to laboratory mains.

Please Contact Sole Selling Agents:

UNIQUE TRADING CORPORATION

221, Sheriff Devji Street, BOMBAY-3

Phone : 30011 **Gram : "UNILAB"**

WHEN YOU REQUIRE

MEASURING INSTRUMENTS & PRECISION TEST-GEAR

FOR DIFFERENT PURPOSES

MAKE IT A POINT TO CONTACT US

We supply:

Moving Coil Movements for Voltage or Current Measurements in any range, RF Single Generators, RC Audio Generators, Marconi Test Instruments and other Testing Elements.

We can also design to your requirements:

Oscillographs, Signal Generators, Rectifier Units, Power Supply Units

State your detailed requirements and get our quotations

We have been designing and supplying to the market various Electrical and Electronic Equipment for over 15 years past

GUARANTEED SERVICE **PROMPT ATTENTION**

RADIO ELECTRIC (PRIVATE) LTD.

28, LAMINGTON CHAMBERS, LAMINGTON ROAD

BOMBAY 4

For

ZOOLOGICAL SPECIMENS

REQUIRED BY

LABORATORIES

AND

INSTITUTIONS

Consult:

Bombay Biological House

Dealers in Zoological Specimens

119, Hindu Colony, Dadar, Bombay 14

Established 1941

Phone : 61813 Gram : PHERETIMA

KINDLY CONTACT US:

* Physics Instruments.
* Laboratory Glassware and Thermometers.
* Laboratory Porcelainware and Silicaware.
* Balances, Analytical, Physical and Chemical.
* Student's Microscopes and all other requirements for Biology Department.
* Ovens, Incubators, Centrifuges, Etc.
* Laboratory Chemicals.
* Movie Projectors, Slide/Filmstrip Projectors, Epidiascopes, Public Address System, Tape Recorders and Cameras for Research Work.

M/s. INDSALES Corporation

11, HORNIMAN CIRCLE

BOMBAY-1

Phone : 253264 Grams : 'ANALYTICAL'

BOROSIL

LABORATORY GLASSWARE

such as

FLASKS, BEAKERS, CONDENSERS, MEASURING FLASKS, MEASURING CYLINDERS, PIPETTES & ANY SPECIAL APPARATUS MADE TO DESIGN

and

PENICILLIN VIALS, VACCINE BULBS— WHITE & AMBER

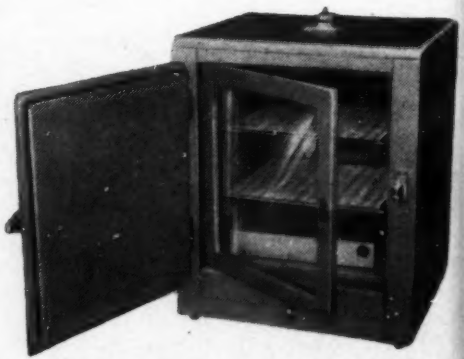
ALL OTHER APPARATUS & EQUIPMENT MANUFACTURED TO CLIENT'S DESIGN

INDUSTRIAL & ENGINEERING APPARATUS CO. (PRIVATE) LTD.

CHOTANI ESTATES, PROCTOR ROAD

GRANT ROAD, BOMBAY 7

TEMPO LABORATORY EQUIPMENT



(INCUBATOR Bacteriological)

TEMPO INDUSTRIAL CORPORATION (PRIVATE) LTD.

Sonary Road, Paranjpe 'B' Scheme, BOMBAY-57

'STANDARD' RHEOSTATS

SINGLE, DOUBLE & FOUR-TUBE

COVER A WIDE RANGE
FOR USE IN
LABORATORIES & WORKSHOPS

Made by:

THE STANDARD SCIENTIFIC
INSTRUMENTS CO.
115, BRODIES ROAD, MADRAS 28

SPECTROSCOPIC EQUIPMENT
AND
ACCESSORIES

FOR
QUANTITATIVE ANALYSIS & RESEARCH WORK

Light sources like Arc Lamps with universal movements, precision slits, mountings for spectrographs, cameras, microphotometers, etc., etc.

Entirely Our Manufacture

For full particulars, please write to:

THE GENERAL
ENGINEERING AND SCIENTIFIC CO.
WALTAIR, VISAKHAPATNAM-3
(S. INDIA)
GRAMS: "ELECTRONIC"
Technical Adviser:
Dr. I. RAMAKRISHNA RAO
M.A., PH.D. (CAL.)., D.SC. (LOND.)

VERY RELIABLE INDIGENOUS SUBSTITUTES
OF GUARANTEED ANALYTICAL REAGENTS
MAY BE FOUND IN

"BASYNTH"
Brand
ANALYTICAL REAGENT

Acid Hydrochloric
Acid Hydrochloric Fuming
Acid Sulphuric
Acid Nitric
Acid Nitric Fuming
Acid Acetic Glacial
Ammonium Hydroxide
Benzene
Toluene
Xylene
Petroleum Ether
Amyl Alcohol
Butyl Alcohol Etc., Etc.

Basic & Synthetic Chemicals (Private) Ltd.
P. O. Jadavpur University, Calcutta-32

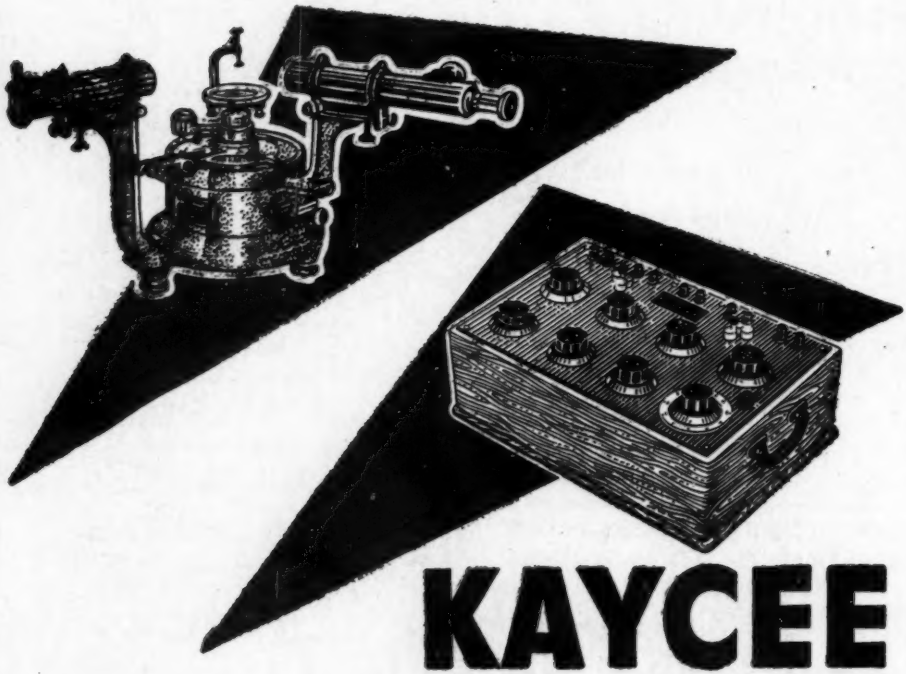
MADE IN INDIA

HIGH VACUUM
ROTARY PUMP
SINGLE STAGE & TWO STAGE
with or without Air Ballast

All Indian materials and construction

BASIC & SYNTHETIC CHEMICALS
(PRIVATE) LTD.
P.O. Jadavpur University, CALCUTTA 32

Dependable and accurate



KAYCEE

Scientific Instruments

for Industries and Educational Institutions

BAJAJ ELECTRICALS LTD.

(Formerly RADIO LAMP WORKS LTD.)

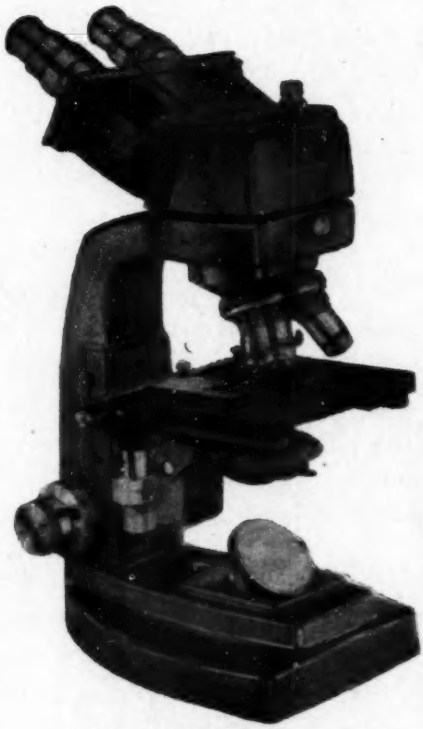
BOMBAY • CALCUTTA • NEW DELHI • MADRAS • KANPUR • PATNA • INDORE • WARDHA • GAUHATI

With a thrill of pride we offer the new

BAUSCH & LOMB

DYNAZOOM

HIGH POWER LABORATORY MICROSCOPE



BAUSCH & LOMB

MONOCULAR

AND

BINOCULAR

CHOICE OF MANY

STAGES AND

CONDENSERS

While the conventional three-objective two-eyepiece microscope gives you just six specific magnifications and no more, the new Bausch & Lomb DynaZOOM gives you an *infinite number of continuously variable magnifications* in the range 17× *through* 1940×. You just turn the MicroZoom power change knob.

For full details of this microscope marvel please write for Catalogue D-185 to

SOLE AGENTS IN INDIA

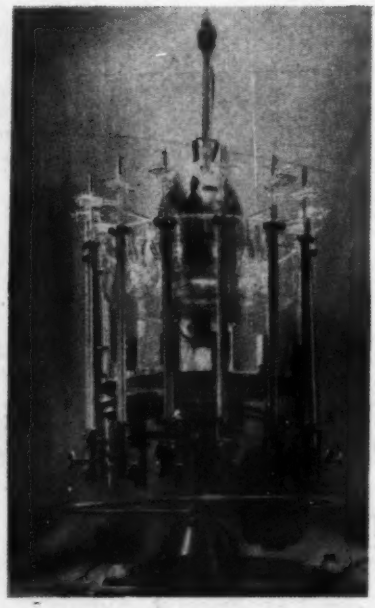
MARTIN & HARRIS (Private) LTD.

(SCIENTIFIC DIVISION)

SAVOY CHAMBERS, WALLACE STREET, BOMBAY 1

BRAUN'S WARBURG APPARATUS

NEW MODEL V-85



The new model V-85 of the well-known Warburg Apparatus has proved highly successful in more than 2,000 Laboratories in all parts of the World.

"Highly accurate temperature control—simple and clear arrangement—little space required—always reliable—double capillary manometers. 14 double capillary manometers are arranged along the circumference of the water-bath which is made from plexiglas." Each manometer can be brought to the front by rotating the manometer platform. Reliable clamping arrangement.

The thermostat system includes a cold cathode relay containing the long-life tube PL 5727; the load on the adjustable contact thermometer is only approximately 10 microamp. The use of heating electrodes effectively avoids all thermal inertia due to heat storage; a small water-bath containing only 10 litres is therefore sufficient for controlling the temperature to within ± 0·0004° C. approx.

Further details on request

Sole Distributors

S|C 1911-1961

THE SCIENTIFIC INSTRUMENT CO., LTD.

ALLAHABAD BOMBAY CALCUTTA MADRAS NEW DELHI